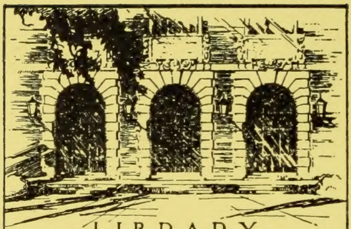

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NORTHWESTERN UNIVERSITY COLLEGE OF ENGINEERING

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BULLETIN OF
Northwestern University
Vol. VIII. April, '09 No. 8

1851

EVANSTON
ILLINOIS

UNIVERSITY OF ILLINOIS
PRESIDENT'S OFFICE

ANNOUNCEMENTS
1909 1910

UNIVERSITY OF ILLINOIS

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1909/10-1924/25

Calendar

PRESIDENT'S OFFICE.

1909

FIRST SEMESTER OF 94 CLASS DAYS

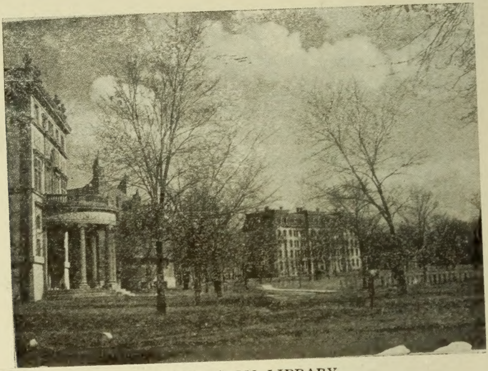
September	27-29—Monday to Wednesday	Registration days.
September	29—Wednesday	Second Examinations.
September	30—Thursday	Class work begins.
November	25-27—Thursday to Saturday	Thanksgiving Recess.
December	23—Thursday	Christmas Vacation begins.

1910

January	4—Tuesday	Class work is resumed.
February	2—Wednesday	Mid-year Examinations begin.
February	10—Thursday	Additional Examinations.

SECOND SEMESTER OF 82 CLASS DAYS

February	11-12—Friday & Saturday	Registration days for Second Semester.
February	14—Monday	Class Work begins.
February	22—Tuesday	Washington's Birthday Recess.
March	25-28—Friday to Monday	Easter Recess.
March	28—Monday	Second Examinations.
May	25—Wednesday	Final Examinations begin.
June	2—Thursday	Additional Examinations.
June	8—Wednesday	Commencement.
June	9—Thursday	Summer Vacation begins.
June	13—Monday	Field work in Surveying begins.
July	23—Saturday	Field work in Surveying closes.



VIEW FROM LIBRARY

The Faculty

Abram Winegardner Harris, Sc.D., L.L.D.	*President*
John Fillmore Hayford, C.E.	*Director*

Olin Hanson Basquin, Ph.D.
Professor of Applied Mechanics
William Charles Bauer, B.S.
Professor of Electrical Engineering
John Fillmore Hayford, C.E.
Professor of Civil Engineering
Leland Wesley Irish, B.E.
Assistant Professor of Civil Engineering

Professor of Mechanical Engineering
Henry Crew, Ph.D.
Professor of Physics
Daniel Raymond Curtiss, Ph.D.
Associate Professor of Mathematics
Ulysses Sherman Grant, Ph.D.
Professor of Geology
Robert Richardson Tatnall, Ph.D.
Assistant Professor of Physics

THEODORE WHITTELSEY, PH.D.
Associate Professor of Chemistry
EDOUARD PAUL BAILLOT, L.H.D.
Professor of Romance Languages
ARTHUR CLARENCE LEWIS BROWN, PH.D.
Professor of English Literature
JOHN SCOTT CLARK, A.M., LITT.D.
Professor of English Language
JAMES TAFT HATFIELD, PH.D.
Professor of German Language and Literature
WILLARD EUGENE HOTCHKISS, PH.D.
Associate Professor of Economics

WALTER LICHTENSTEIN, PH.D.	*Librarian*
ROBERT EDWARD WILSON, PH.M.	*Registrar*

Historical Note

The charter of Northwestern University was signed by the Governor of Illinois on January 28, 1851. The corporation consists of forty-four trustees. An amendment to the charter provides that no intoxicating liquors shall be sold within four miles of the University.

The trustees selected as the seat of the University a tract of land on the shore of Lake Michigan, twelve miles north from the heart of Chicago. Here in 1853 the first University building was erected and about its location has grown up the City of Evanston. Here are the College of Liberal Arts, the College of Engineering, the School of Music; the schools of Medicine, Law, Pharmacy, Dentistry and Commerce, are located in the City of Chicago.

The College of Liberal Arts, the oldest department of the University, was opened to students in the fall of 1855. From its small beginning it has grown, not by rapid expansion or by large benefactions, but by steady gains along conservative lines—each of its fifty-three years adding some improvements to its physical and educational equipment.

Its faculty numbers forty professors, twenty-two instructors and fourteen other officers giving instruction; its students number over one thousand. The work of the College of Liberal Arts is mainly directed toward furnishing opportunities for a liberal culture or general education. The regulations affecting the choice of studies are such that the student may elect a large part of his work along lines in which he is especially interested.

A demand for instruction in engineering was felt early in the history of the University. An early catalogue states: "This year (1854) the trustees ordained the regular classical and scientific courses and planned for schools of Applied Science and of Law." Fourteen years after the opening of the College of Liberal Arts a Professor of Civil Engineering was appointed and a course in Civil Engineering was organized. This proved so popular that four years later, it was thought wise to set up a *College of Technology* which offered three courses—one in Civil Engineering, one in Chemistry, and one in General Science. In the financial troubles that prevailed throughout the country in the seventies the attendance upon this college fell off so markedly that its dean reported in 1877 that "the demand for technological studies has almost entirely ceased" and the new college was given up. Engineering degrees had been conferred upon sixteen graduates.

In recent years the demand for engineering instruction has again made itself felt. Year by year, during ten years studies in the fundamental principles of engineering have been added in different departments of instruction in the College of Liberal Arts. For whatever line of engineering work the student has wished to fit himself, he has found the equivalent of about one-half of his technical course offered in this college, and he has been urged to remain here four years to complete a liberal education before going elsewhere to finish his specialized instruction in engineering.

The proposal to establish an Engineering College that should give a high grade of instruction in engineering subjects to students who have had sufficient preliminary work in the College of Liberal Arts was received with so much favor by friends of the University that Mrs. Gustavus F. Swift, of Chicago, and her son, Edward F. Swift, generously gave funds for the erection of an engineering building and for its endowment. Swift Hall of Engineering was completed in March, 1909. The Trustees took action in June, 1907, which resulted in the establishment of the College of Engineering.

DECORATIVE DESIGN
USED IN SWIFT HALL OF ENGINEERING

VIEW OF THE LAKE FROM SWIFT HALL OF ENGINEERIN

The Design

In the work of the College of Engineering it is proposed to emphasize certain features

Each engineering course will extend through five years and will require satisfactory employment during a part of each summer vacation. This extension of the time beyond the usual four year course is made because of the large amount of liberalizing work introduced, and because five years is not too long a period for the intelligent young man to spend in preparation for the higher positions in engineering.

The fundamental principles of engineering as found in the various sciences will be fully elaborated and illustrated in the engineering courses and the arts of engineering will be given the attention needed to insure a practical understanding of the application of principles. Principles are not many, but they are permanent, and a knowledge of them gives an intelligent understanding of the value of an art.

A liberal education is believed to be essential to the highest success of the engineer, and the attempt is made to give every student such an education, along with his engineering work. To this end the studies required by the College of Liberal Arts for the degree of Bachelor of Science are included in each course of the Engineering College. Through the co-operation of the Colleges of Arts and Engineering, the engineering student is a member of both Colleges; he is thrown with the Arts students in many of his classes and in all social and athletic privileges. Graduates who share such privileges and actually receive an Arts degree can hardly fail to consider themselves true College Men.

The studies embraced in the engineering courses demand serious effort on the part of the student. The regular courses are planned for seventeen exercises a week; and good work upon the part of the student is insisted upon. Students are advised to make financial arrangements that will enable them to devote their entire time to College duties.

Admission

Candidates for admission to the First Year of the College of Engineering must be at least sixteen years of age and must present certificates of scholarship which enumerate and describe the studies pursued in preparation for college. Blank certificates may be had on application, and, in order to make sure that the required information is given, these certificates should be filled out and returned to the College of Engineering some time before the opening of the college year.

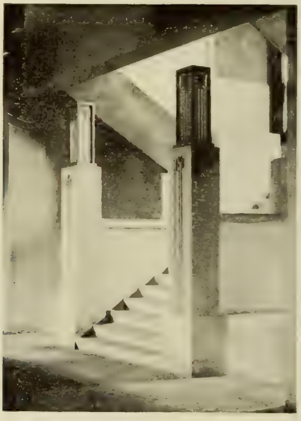
A unit of secondary work is a study requiring a prepared recitation on each day of the school year—two hours of laboratory work being counted as the equivalent of one prepared recitation.

The certificates must show satisfactory preparation in at least fifteen units distributed as below.

English,	3 units required
Algebra,	1.5 units required
Plane Geometry.	1 unit required
History,	1 unit required, preferably Ancient History
Science,	1 unit required, preferably Physics
Foreign Language,	4 units required, not less than two units in any one language. First preference: 2 units of German and 2 units of French. Second preference: 3 units of Latin and 2 units of German.

The remaining units may include any of a large number of subjects, but should include solid geometry, one-half unit.

On the days mentioned in the Calendar as Registration Days, the Board of Examiners is in session and reviews the preparation of the student, as shown by the student himself and by the certificate which he presents. Particular attention is given by this board to preparation in Mathematics and in English composition.



STAIRWAY IN ENGINEERING HALL

Advanced Standing

A student of another college may secure admission to this college by presenting an honorable dismissal from the college last attended together with a certificate showing the extent, character and grade of his college work. The advanced credit to be allowed him is determined by a special committee of the Faculty. Work done elsewhere than in an approved college may be given credit on examination.

Courses of Study

The College of Engineering offers two courses of study, alike in character and nearly the same in content; in the first, Civil Engineering subjects receive the most attention while in the second course, Mechanical and Electrical Engineering are emphasized; the arts and science work is the same in both courses. For the satisfactory completion of either five-year course a bachelor's degree in Engineering will be conferred by the College of Engineering. The work of the first four years of either course fulfills the requirements for the degree of Bachelor of Science, and that degree will be conferred by the College of Liberal Arts upon the satisfactory completion of its requirements.

Every student on admission to the College of Engineering pays a Matriculation fee of five dollars; the tuition is fifty dollars a semester; other fees are noted below in connection with the studies to which they apply.

Description of Studies

The studies described below belong to both courses unless otherwise noted.

FIRST YEAR STUDIES

MATHEMATICS A3—*Algebra, Trigonometry, and Analytical Geometry.* First Semester: Algebra and Plane Trigonometry; Second semester: Analytical Geometry, an elementary course on the straight line and conic sections with an introduction to the geometry of three dimensions. Five recitations a week. Mr. Wilson and Mr. Marietta.

CHEMISTRY A—*Elementary General Chemistry.* Text and laboratory work. Those who have had some elementary Chemistry, but not sufficient to qualify for Course B, may have the laboratory work modified so as to avoid unnecessary repetition of work already done. Credit is not given unless the full course is completed. Laboratory deposit $7.50 a semester. Two recitations and five hours laboratory work a week. Professor Young and Professor Hines.

ENGINEERING A1—*Mechanical Drawing.* An introductory study in which accurate work is made a special feature; the use and care of instruments; freehand sketching in orthographic projection; practice in the general methods used in the drawing room in preparation for practical work. Laboratory fee, $3.00 a semester. One afternoon a week. Professor Irish

ENGINEERING B1—*Freshman Shop Work.* A study of the simple tools commonly used in wood and metal working, special attention being given to the mechanical study of their cutting action. Laboratory fee $4.00 a semester. One afternoon a week. Professor Basquin and Mr. ———

ENGLISH LANGUAGE A—*Rhetoric; Synonyms; Eight Essays.* First semester: Drill in the elements of good style.

FIRST YEAR STUDIES

Second semester: Rhetorical imagery and synonyms. Students who show, early in the first semester, that they are seriously deficient in elementary English, are required to take additional work for such time as may be found necessary. No credit is given till the whole course, including the additional work, if any, is completed. Three recitations a week. Mr. Sherburn, Mr. Stevens and Mr. Burrill.

NOTE. *In modern languages the student will preferably register for German A or French A, but if on admission he has presented credit in neither German nor French he will register for German AA or French AA.*

GERMAN A—*Intermediate German.* Some sections take Modern Prose writers, Storm, Freytag, Seidel, Ernst, etc. German lyrics and ballads, Goethe's Hermann und Dorothea. Other sections take Lessing's Minna von Barnhelm, German lyrics and ballads, Schiller's Wilhelm Tell and Maria Stuart, Goethe's Hermann und Dorothea. Adequate preparation for this study is German AA or two years of secondary school work in German. Three recitations a week. Professor Curme, Professor Edward, Mr. Bernstorff, and Dr. Roloff.

FAYERWEATHER HALL OF SCIENCE FOR PHYSICS AND CHEMISTRY

FIRST YEAR STUDIES

GERMAN AA—*Elementary German.* Pronunciation, grammar, selections in prose and verse, German compositions. Credit will not be given unless the full course is completed. Open only to students who have presented four units of foreign languages for admission. Five recitations a week. Professor Edward, Mr. Bernstorff, and Dr. Roloff.

GERMAN AB—*Intermediate German.* Open to students who have presented one unit of German for admission and completes their preparation for German A. Three recitations a week. Mr. ————————

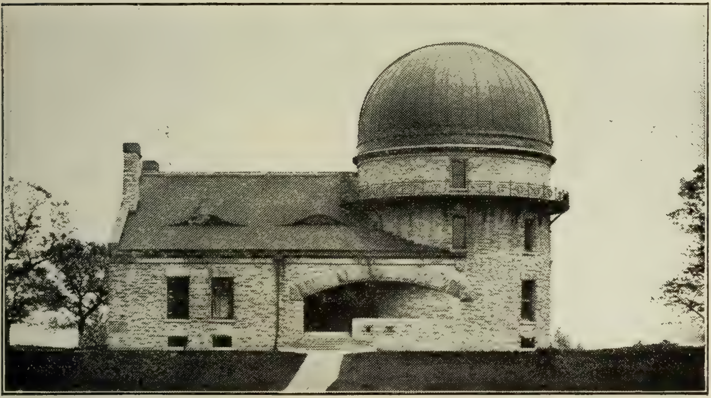
FRENCH A—*Modern French.* Baillot-Brugnot's Composition. Advanced grammar and reading. Madame de Girardin's La Joie fait Peur. Eugéne Scribe's Les Doigts de Fée. Coppée's On rend l'Argent. Freeborn's Contes de Daudet. Pailleron's Le Monde où l'on s'Ennuie. White's Contes de Maupassant. Victor Hugo's Quatre-Vingt Treize. Canfield's French Lyrics. Coppée's Le Pater Victor Hugo's Hernani. Private reading: Cameron's Selections from Loti. Hennequin's Lessons in Idiomatic French. Essays. Adequate preparation for this study is French AA or two years of secondary school work in French. Three recitations a week. Professor Baillot, Mr. Kuhne, and Dr. Harry.

FRENCH AA—*Elementary French.* DeBordes' Grammar. Whitney's Reader. Labiche's La Grammaire. Mérimée's Colomba, Sicard's Easy French History. Baillot-Brugnot's Composition. Labiche-Martin's Voyage de M. Perrichon. Papot-Williamson's Easy French Stories. Sand's La Petite Fadette. Simple dictation, private reading, and composition. Credit will not be given unless the full course is completed. Five recitations a week. Mr. Kuhne, Dr. De Salvio, and Dr. Harry.

FRENCH AB—*Intermediate French.* Open to students who have presented one unit of French for admission and completes their preparation for French A. Three recitations a week. Dr. Harry.

SUMMER WORK

The student will procure some practical work for at least six weeks of the summer the nature of which to be approved in advance by the Faculty.



DEARBORN ASTRONOMICAL OBSERVATORY

SECOND YEAR STUDIES

MATHEMATICS B1—*Differential and Integral Calculus.* Rules for differentiation; infinitesimals and differentials; theorems of mean value; limiting values; partial differentiation; Taylor's theorem; indefinite and definite integrals; applications to geometry and mechanics. Three recitations a week. Professor Curtiss and Dr. Moore.

PHYSICS A—*General Physics.* First semester: General properties of matter, sound, heat. Second semester: Electricity, magnetism, light. An introductory course requiring no mathematics beyond the requirements for entrance to college, intended to acquaint the student with the elementary facts and the general principles of physical science. Textbook: Crew's General Physics. Laboratory fee $2.00 a semester. Three class exercises and one afternoon laboratory work a week. Professor Tatnall.

ENGINEERING C1—*Surveying.* Care and use of the chain, tape, rods, compass, level, transit, solar transit, plane table, current meter, sextant, hand level, prismatic compass, with the theory and method of making land, city, topographic, hydrographic, railroad, highway, mine, and tunnel surveys, and platting field notes; also sufficient Astronomy for the determination of latitude and longitude. Absence from field work in this study must not occur without previous notice to the instructor in charge. Laboratory fee $5.00 a semester. Two recitations a week and Saturday morning in field work. Professor Irish.

ENGINEERING A2—*Sophomore Drawing.* Under the head of descriptive geometry this study embraces a treatment of the theoretical principles of orthographic projection as used in the practice of advanced mechanical drawing; under the head of graphical statics it treats of methods of finding the forces which act between the parts of framed structures as a result of the loads which they support; while under the head of kinematics it acquaints the student with the more important mechanical motions and gives him some practice in applying them to machine parts. Laboratory fee $3.00 a semester. One recitation and two afternoons in the drawing room a week. Professor Irish.

ENGINEERING B2—*Sophomore Shop Work.* A more advanced study than Engineering B1. Laboratory fee $4.00 a semester. One afternoon a week. Professor Basquin and Mr. ——————

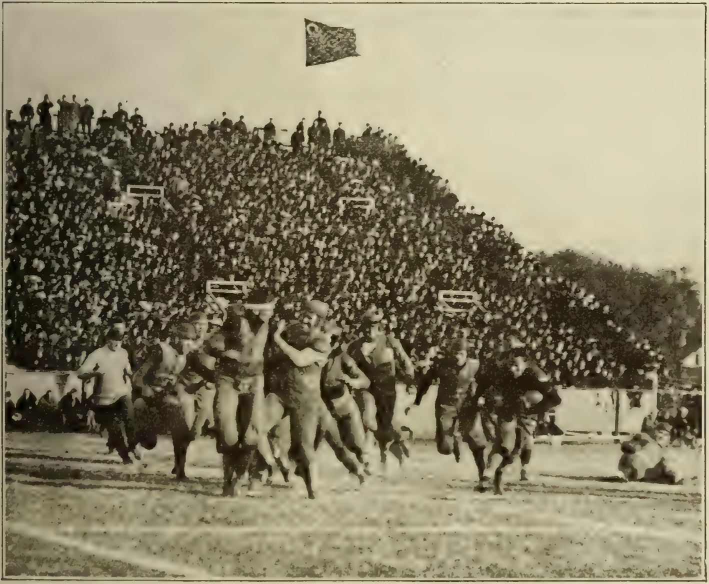
MODERN LANGUAGES—The studies in German and French are described under the First Year's work. The student will preferably register for French A or German A. *Both of*

SECOND YEAR STUDIES

these courses must be completed by the end of the fourth year unless three units of Latin or of Greek have been presented for admission, in which case only one of them is required.

SUMMER WORK

ENGINEERING C2—*Field Work in Surveying.* Practice in the more important classes of surveying under conditions met with in actual surveying work. The class is divided into small sections of which the members take charge in rotation and the assignment of work is so arranged that each man gets a considerable experience with each of the important instruments and with the various duties involved in the making of surveys. Open to students who have completed Engineering C1. Six weeks in the summer. A fee of thirty dollars is charged for this study. Professor Irish.



AN INTERCOLLEGIATE GAME

THIRD YEAR STUDIES

MATHEMATICS C1—*Advanced Calculus.* Infinite series; Taylor's theorem; partial differentiation; differential geometry; definite integrals over curves, surfaces and volumes; the Eulerian functions; Fourier's series; differential equations. Three recitations a week. Professor Curtiss.

PHYSICS B—*Mechanics.* An elementary experimental study of forces, moments of force, moments of inertia, elasticity, hydro-mechanics, an introduction to advanced physics and engineering. This is a study in pure dynamics, and serves as an introduction to Applied Mechanics. Textbook: Crew's Principles of Mechanics. The laboratory work is guided by especially prepared instructions. Laboratory fee $2.00 a semester. Two recitations and one afternoon in laboratory work a week. Professor Crew and Professor Tatnall.

PHYSICS C—*Electricity and Magnetism.* The more general laws of electricity and magnetism are discussed; the practical equations employed in the laboratory are derived and discussed. Text-book: J. J. Thomson's Elements of the Mathematical Theory of Electricity and Magnetism. The laboratory work includes the measurement of current, by one or more methods, resistance, electromotive force, temperature-coefficients, capacity; a study of the magnetic properties of iron and steel, thermo-electric effects, the use of Carey Foster bridge, potentiometer, copper voltameter, etc. Laboratory fee $3.00 a semester. Two recitations and one afternoon in laboratory work a week. Professor Crew.

GEOLOGY A1—*General Geology.* A general introduction to Geology. Occasional excursions or laboratory work on Friday afternoons or Saturdays. Laboratory fee, $2.00 a semester. Three recitations and one hour laboratory work a week. Professor Grant and Professor Mansfield.

CHEMISTRY B—*Qualitative Analysis; Organic Chemistry* Lectures, recitations and laboratory work. Laboratory deposit $9.00 a semester. Three recitations and six hours in the laboratory a week. Professor Whittelsey.

SUMMER WORK

The student will procure some practical work for at least six weeks of the summer vacation, the nature of which to be approved in advance by the Faculty.

ANNIE MAY SWIFT HALL OF SCHOOL OF ORATORY

FOURTH YEAR STUDIES

ECONOMICS A—*Elements of Economics.* An elementary course in economic theory. The first semester is devoted to the fundamental principles of value. In the second semester these principles are applied to practical economic problems. The work of the second semester varies in the different sections. Three recitations a week. Professor Hotchkiss, Professor Howard, and Mr. Deibler.

ENGLISH LITERATURE A—*General View of English Literature.* A general outline of the development of English literature. Lectures, recitations, and a considerable amount of reading. One lecture and one recitation a week. Professor Brown, Professor Goddard, and Dr. Chase.

FOURTH YEAR STUDIES

GEOLOGY B5—First semester only—*Fuels, Refractory Materials, Metallurgy of Iron and Steel.* Two exercises a week. Mr. Coghill.

ENGINEERING D1—Second semester only—*Contracts and Specifications.* Two recitations a week. Mr. ————

ENGINEERING D2—*Journal Meeting.* Critical reports by the students upon engineering topics of current interest. One meeting a week. Director Hayford.

ENGINEERING H2—*Structural Mechanics.* A study of the behavior of cast iron, steel, stone, and concrete under the action of stress, with a discussion of the strength, deformation under load, and the proper design of beams, columns, joints, etc. Experimental work upon the strength of materials is carried out by the class under the leadership of each of its members in rotation. Laboratory fee $5.00 a semester. Two recitations and one laboratory period a week. Professor Basquin.

ENGINEERING J1—*Engines.* Fundamental principles of thermodynamics with their applications to heat engines. Laboratory work on one afternoon will be frequently substituted for the recitation on that day. Three recitations a week. Laboratory fee $3.00 a semester. Required in Civil Engineering Course. Professor Bauer.

ENGINEERING E1—*The direct current circuit and direct current machinery.* Laboratory work on one afternoon will be frequently substituted for the recitation on that day. Laboratory fee $3.00 a semester. Three recitations a week. Required in the Mechanical and Electrical Engineering Course. Professor Bauer

An elective study of three hours a week in the Civil Engineering Course will be confined to the work offered by the Department of Geology. The following studies are available:

GEOLOGY B1—*Practical Geology.* First semester: A more advanced study of structural and dynamical geology than is given in Geology A1. Second semester: Methods

FOURTH YEAR STUDIES

of geological work, preparation of maps and sections, geologic and topographic mapping. Two recitations and one laboratory period a week. Professor Grant and Mr. Higgins.

GEOLOGY B2—*Physiographic and Glacial Geology.* First semester: Physiographic and general geology of the United States. Second semester: Glacial Geology. Two recitations and one laboratory period a week. Professor Mansfield and Mr. Decker.

GEOLOGY B3—*Mineralogy.* Crystallography, blowpipe analysis, and determinative mineralogy. One lecture and three laboratory periods a week. Laboratory fee $2.00 a semester. Mr. Coghill.

CENTRAL HEATING PLANT

Students in the Mechanical and Electrical Engineering course will take an elective study of 3 hours a week which is not restricted to any department. Attention is called to the following studies:

CHEMISTRY C—*Quantitative Analysis.* First semester: Gravinetric analysis. Second semester: Volumetric Analysis. Six hours in the laboratory a week. Laboratory deposit $9.00 a semester. Professor Whittelsey.

ENGLISH LITERATURE D—*Shakespeare.* First semester: A careful and detailed study of three of Shakespeare's plays. Second semester: All of Shakespeare's plays are read in

FOURTH YEAR STUDIES

chronological order. Lectures on the development of Shakespeare's art and on his relations to preceding and contemporary dramatists. Three lectures or recitations a week. Professor Brown

HISTORY A—*English History*. English political history from the Anglo-Saxon period to the present day. In addition the development of governmental institutions and the condition of the church receives some attention. Three recitations or lectures a week. Drs. Terry and Lichtenstein.

HISTORY BC—*American History*. The Political History of the United States from the Revolution. The formation of the Union, the rise and growth of parties, the influence of westward expansion and of slavery on the political life. Three lectures a week. Professor James.

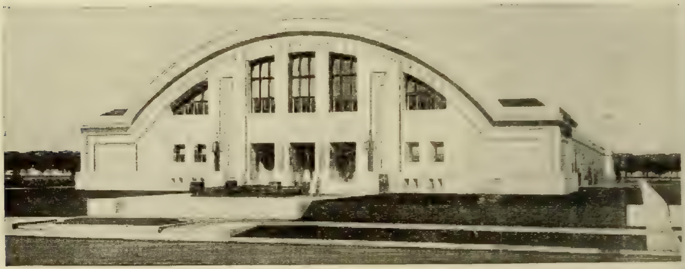
MATHEMATICS D1—*The Partial Differential Equations of Mathematical Physics* Three lectures a week. Prof. Curtiss.

BACHELOR OF SCIENCE DEGREE

On the satisfactory completion of the first four years of either course the degree of Bachelor of Science will be conferred by the College of Liberal Arts. The graduation fee is ten dollars.

SUMMER WORK

The student will procure some practical work for at least six weeks of the summer vacation, the nature of which to be approved in advance by the Faculty.



THE NEW GYMNASIUM

FIFTH YEAR

The fifth year's work will not be taken up during the year 1909-1910, but will be offered in 1910-1911. An exact description of the studies which will comprise this year's work cannot now be fully given. The work will doubtless follow very closely the outline shown below.

CIVIL ENGINEERING—

Theory and Design of Structures.
Bridges and Their Design.
Railway Engineering.
Hydraulic Engineering.
Thesis.
The Public Relations of the Engineer.

MECHANICAL AND ELECTRICAL ENGINEERING—

Thermodynamics.
Engines.
Alternating Current Engineering.
Hydraulic Engineering.
Thesis.
The Public Relations of the Engineer.

On the satisfactory completion of this fifth year's work the student will receive a Bachelor's degree in Engineering. The University charges a fee of $10.00 upon the giving of any degree.

UNIVERSITY HALL

Grounds and Buildings

Engineering students are given instruction in literary and scientific subjects in the same classes with the other college students and in the buildings of the University now occupied by such departments.

THE CAMPUS extends for three-quarters of a mile along the shore of Lake Michigan, and is bordered by Sheridan Road on the west and south. On the southern half of the campus stands the earliest building, Old College. Near by are University Hall, Fisk Hall, the home of the Academy; Annie May Swift Hall, occupied by the School of Oratory; the Old Gymnasium; Fayerweather Hall of Science; Heck Hall, a dormitory for men, and Memorial Hall, both of the Garrett Biblical Institute; Orrington Lunt Library, and Swift Hall of Engineering. On the north campus are Hatfiled House—a men's dormitory; the Dearborn Astronomical Observatory and the new Gymnasium. One block to the west is Music Hall of the School of Music, and three dormitories for women, Willard Hall, Pearsons Hall, and Chapin Hall. In the extreme southeastern corner of the Campus is a building peculiar to Northwestern University—the U. S. Life Saving Station. The crew, composed of students, has a record of over thirty years of service. Northwestern Athletic Field with bleachers and training quarters is about a mile northwest of the Campus.

UNIVERSITY HALL, a capacious stone structure of attractive architecture, was erected in 1869. It contains the President's office, the administrative offices of the College, lecture and recitation rooms, and private offices for professors, also the botanical,geological,and zoological laboratories.

FAYERWEATHER HALL OF SCIENCE, erected in 1886, was the gift of Mr. D. B. Fayerweather, of New York. It is constructed of stone and brick, with terra-cotta trimmings. The front is 130 feet, and the depth 60 feet. At the rear are two wings, extending back 54 feet, enclosing a court in which the power house for the building is located. It is divided into two sections, for physics and chemistry, separated by a fireproof wall. The department of Physics is well equipped. A large collection of lecture room apparatus is at hand for purposes of demonstration. The apparatus in the laboratory used by first year students is in sets, so that numbers of students can work on the same experiment at one time.

SWIFT HALL OF ENGINEERING

Apparatus of new design has been collected to illustrate the course in mechanics; the electrical laboratory is fitted with the most accurate and modern instruments. The chemical laboratories consisting of those for general chemistry, qualitative analysis, quantitative analysis, water analysis, and of two private laboratories are commodious and well equipped.

SWIFT HALL OF ENGINEERING, the gift of Mrs. Gustavus F. Swift and her son, Mr. Edward F. Swift, was completed in the early part of 1909 and is an imposing stone structure, the architecture and lines being chaste in the extreme. The interior walls are of plaster and of pressed brick. The floors are reinforced concrete, and tile. Broad and easy stairs, also of reinforced concrete extend from the basement to the attic, thus making the building virtually fire proof. This building is 126 feet wide, 58 feet deep and is located within one hundred and fifty feet of the lake near the central part of the campus. It has an excellent basement three full stories, and an exceptionally useful attic, and is modern in every respect. Special attention has been given in the design to the lighting, heating and ventilation.

The basement floor will accomodate an engine laboratory and a dynamo laboratory; the ceiling has been made exceptionally high and the windows are ample so that this will be as valuable a working floor as any other in the building. Steam from the power plant is transmitted to the building at high pressure and will be there utilized for experimental purposes. Prime movers such as steam engines, gas engines and the like will be placed in this engine laboratory. The dynamo laboratory will accomodate a large number of students and will be used for both direct and alternating current work. In this laboratory the conduits which are to be used for experimental purposes have been placed in the floor making any kind of current easily accessible from all parts of the laboratory.

On the first floor is a spacious lecture hall seating 200 persons and a laboratory for the study of hydraulics. The lecture room is lighted by indirect illumination and is superior in every detail. The hydraulic laboratory will be given up to the study of static pressure of water, its flow in channels, jets and over weirs, also the flow of steam and air. The building is provided with an elevator making it possible for apparatus to be taken conveniently from various parts of the building and to be exhibited in the lecture room

The second floor will be given up to a laboratory and lecture room in mechanics, a library, reading room for students and for the use of the Engineering Club, and to recitation rooms and offices. The recitation rooms in the south end of this floor will be used temporarily by the department of mathematics.

The third floor will accommodate a large drawing room, offices, class rooms, and a model room.

The fourth floor comprises a drawing room, blue print room, dark room, machine shop, and a large space for the storage of apparatus. This floor is lighted by means of a sky light extending around the entire building which gives an ideal light for drawing and other purposes.

ORRINGTON LUNT LIBRARY is a structure of Bedford limestone, erected in 1893. Its dimensions are 162 feet by 73 feet. The main floor contains the reading room, the offices of administration and a room for book storage. On the second floor is an auditorium with seating capacity for three hundred persons, a large room occupied by the Art Collection, and other rooms for class, seminary, and office use. In the third story, which extends over the central section of the building, and in the well-lighted basement, are rooms used for recitations and for general University purposes. The library contains 68,000 bound volumes to which the students have access

DEARBORN OBSERVATORY is a substantial stone building, erected in 1888 through the generosity of Mr. James B. Hobbs, of Chicago. Its length from north to south is 81

THE LIBRARY

feet, and its greatest breadth is 71 feet. It includes a dome for the great Equatorial Telescope, a Meridian Circle room, a Library, and eight additional rooms, the whole being arranged especially for convenience in carrying on astronomical work

THE NORTHWESTERN GYMNASIUM, in course of construction, is the gift of Mr. James A. Patter, a member of the board of trustees. It is located just north of the center of the campus, is about 150 feet wide and over 300 feet deep, and will be a beautiful as well as the largest college gymnasium in the country. The architectural features of this building harmonize with the beauty of the campus.

Provision for athletic sports is afforded by the somewhat novel feature of an indoor field. This field has a dirt floor surrounded by a ten-lap running track 12 feet wide. The dimensions of this field are 215 by 120 feet, without obstructions, the roof being supported by immense steel arches rising 54 feet at the highest point. To realize that this is a veritable indoor field one needs only to reflect that two full-sized baseball diamonds may be laid out within the track, and that six tennis courts with ample space at either end for players, placed in this field would still leave space enough for 2000 spectators if stands were erected along the side walls. This field will be heated in cold weather and will insure opportunity for athletic games and indoor track work at any season of the year.

In addition to the indoor field a gymnasium with floor space of 7200 square feet, will be fitted up with all necessary apparatus for class work. This gymnasium floor will be at the west end of the building. On the north side of this large room will be a smaller room, to be used for boxing, fencing, wrestling, and exercise on special apparatus. A swimming pool 60x25 feet, complete with filter and heating apparatus will provide for aquatic exercise.

Athletics

Eminently sane and healthful athletic conditions exist throughout the University. The facilities for exercise are used to the fullest extent, a large proportion of the entire student body taking some form of regular exercise. Instead of spending a large amount of energy upon a few great athletic games, it is the policy of the University to get the great mass of the students to enter various forms of athletic contests—not as onlookers but as contestants. In this way, all secure the physical benefit as well as the pleasure. The general result is not only increased health and vigor among the students but a spirit of good fellowship and comradeship so delightful in college and so essential for a successful career in after life.

Social Life

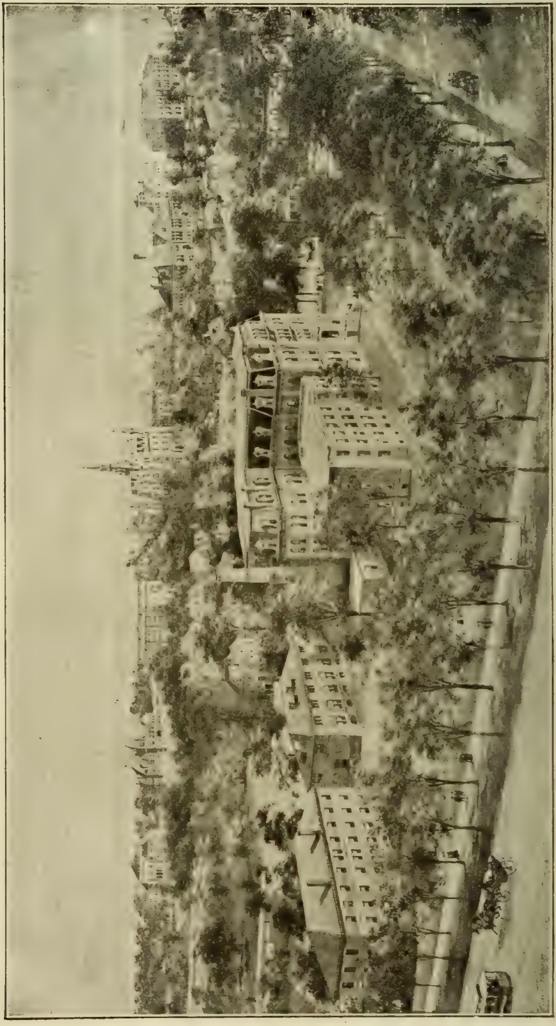
The social life of the students is cultivated in many ways. At the beginning of the year new students are met at the trains by student committees, are made welcome to the University, and are given any assistance needed in getting settled in Evanston and in registering in the University Receptions are held for the purpose of furnishing an opportunity of getting acquainted with the new students, and an attempt is made to make the new student feel at home; later in the year a series of receptions are given to the University students by the faculty, and socials are given by the various class organizations.

About half of the students belong to fraternity chapters. These are societies of from fifteen to thirty men each, the majority of whom live and work together somewhat as a family of brothers in one house. This manner of living furnishes many advantages and opportunities well worth consideration. While the fraternity duties and pleasures take some time which might be given to study the fraternities keep a careful watch over the scholastic record of their members and are not slow to apply the spur to the man who is falling behind in his work.

Many interesting and instructive lectures and musical recitals are provided for the students. Some of them are regular appointments and some come through the courtesy of prominent men who are visiting the University for other purposes.

The Young Men's Christian Association is a vigorous organization. The work is under the charge of a competent secretary, who gives all his time to this work. It maintains an employment bureau, provides a lecture course, and is the main center of general University spirit among the men students.

The students at Evanston enjoy the advantages of a large city, its libraries, art collections, churches etc., without



BIRD'S EYE VIEW OF THE CAMPUS

having to endure its disadvantages. For an engineering student, Chicago offers many advantages, its railroad systems, its underground tunnels thirty miles in length, its movable bridges, its steel works, its drainage canals, its parks and engineering societies all prove of interest and benefit.

In all departments Northwestern University numbers over 4,000 students and over 350 instructors. It has many and varied interests—all working harmoniously together. The student who is a part of such an army develops a sense of loyalty, dignity and responsibility, always urging him toward better things

While the University as a whole is large, the benefits of the small college are not lost, as the various schools composing the University are of moderate size. The students become widely acquainted and the classes are not overcrowded. The professors come to know the students thoroughly. Each student has assigned to him some member of the faculty as his adviser, to whom he explains his plan of work and whom he consults on all matters of importance.

For further information concerning the College of Engineering address Registrar, College of Engineering, Northwestern University, Evanston, Illinois.

University Directory

Abram Winegardner Harris, Sc. D., LL.D., *President*

Special announcements of the several departments of the University may be had on application Address inquiries to the following:

College of Liberal Arts . . . . The Registrar
University Hall, Evanston

Medical School . . . . The Secretary
2431-2437 Dearborn Street, Chicago

Law School . . . . The Secretary
Northwestern University Building, Chicago

College of Engineering . . . . . . The Registrar
Swift Hall of Engineering, Evanston

School of Pharmacy . . . . The Registrar
Northwestern University Building, Chicago

Dental School . . . . The Secretary
Northwestern University Building, Chicago

School of Music . . . . The Secretary
Music Hall, Evanston

School of Oratory . . . . The Director
Annie May Swift Hall, Evanston

Evanston Academy . . . . Evanston, Illinois
Arthur Herbert Wilde, Ph.D., Principal

For general information address the President
87 Lake Street, Chicago, Illinois

UNIVERSITY OF ILLINOIS
PRESIDENT'S OFFICE.

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Northwestern University Bulletin

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COLLEGE OF ENGINEERING ANNOUNCEMENTS

1910-1911

UNIVERSITY OF ILLINOIS

PRESIDENT'S OFFICE

JUN 28 1910

1851

EVANSTON, ILLINOIS

Northwestern University

¶ NORTHWESTERN UNIVERSITY is an institution for the earnest and ambitious student, for the young man or woman who wants to make the most of himself and to appropriate the best that the University has to give him.

¶ NOT ONLY THE COLLEGE OF ENGINEERING, but all the departments of the University are equipped in instruction and apparatus to meet in the largest way the needs of the student.

¶ TO MANY, PERHAPS TO MOST STUDENTS, better education means sacrifice. The University appreciates this; indeed, the institution is itself built upon this principle. Its fees fail much of meeting its expenses. Beneficence to the institution is, in fact, a gift to every student, securing to him his education at less than it costs.

¶ NORTHWESTERN HAS HAD A WORTHY HISTORY, but the future is to afford the students better privileges than ever. New resources provide new opportunities; a wiser use of the old resources will make them increasingly serviceable.

¶ COULD ANY UNIVERSITY BE MORE FAVORED in its site than one in Chicago and Evanston, the first the center of the strongest and best forces of our national life, the second the city's most beautiful suburb, set down by the Lake and marked from the beginning for the home of students?

¶ ADDRESS THE PRESIDENT FOR ANY INFORMATION regarding any department; visit the institution; give it the opportunity to serve you.

Evanston and Chicago

Northwestern University Bulletin

COLLEGE OF ENGINEERING ANNOUNCEMENTS
1910-11

UNIVERSITY OF ILLINOIS
PRESIDENT'S OFFICE

Volume X, Number 16

Evanston
Published by the University
May, 1910

The College of Engineering

THE FACULTY.

Abram Winegardner Harris, Sc. D., LL. D.
President

John Fillmore Hayford, C. E.
Director

Olin Hanson Basquin, Ph. D.
Professor of Applied Mechanics

William Charles Bauer, B. S.
Professor of Electrical Engineering

William Henry Burger, B. S.
Assistant Professor of Civil Engineering

Milby Roy Hammer, B. S.
Assistant Professor of Drawing

John Fillmore Hayford, C. E.
Professor of Civil Engineering

Henry Crew, Ph. D.
Professor of Physics

Daniel Raymond Curtiss, Ph. D.
Professor of Mathematics

Ulysses Sherman Grant, Ph. D.
Professor of Geology

Robert Richardson Tatnall, Ph. D.
Associate Professor of Physics

Murray Arnold Hines, Ph. D.
Assistant Professor of Chemistry

Edouard Paul Baillot, L. H. D.
Professor of Romance Languages

Arthur Clarence Lewis Brown, Ph. D.
Professor of English Literature

J. Scott Clark, A. M., Litt. D.
Professor of English Language

James Taft Hatfield, Ph. D.
Professor of German Language and Literature

Willard Eugene Hotchkiss, Ph. D.
Professor of Economics

Walter Lichtenstein, Ph. D.
Registrar

CALENDAR 1910-11

1910	
Sept. 19, Monday	Academic year 1910-11 begins; examinations for admission; first day of registration.
Sept. 21, Wednesday	Second examinations.
Sept. 22, Thursday	Class work begins.
Nov. 24, Thursday	Thanksgiving Recess, to November 27, Sunday, inclusive.
Dec. 23, Friday	Christmas Recess, to January 3, Tuesday, inclusive.
1911	
Jan. 4, Wednesday	Class work resumed.
Jan. 28, Saturday	Qualifying examinations.
Feb. 1, Wednesday	Mid-year examinations begin.
Feb. 10, Friday	Second semester begins.
Feb. 11, Saturday	Second examinations.
Feb. 13, Monday	Class work resumed.
Feb. 22, Wednesday	Washington's Birthday.
April 14, Friday	Easter Recess, to April 17, Monday, inclusive.
April 17, Monday	Second examinations.
May 27, Saturday	Qualifying examinations.
May 30, Tuesday	Memorial Day.
May 31, Wednesday	Regular examinations begin.
June 14, Wednesday	FIFTY-THIRD ANNUAL COMMENCEMENT.
June 19, Monday	Beginning of field work in surveying.
July 29, Saturday	End of field work in surveying.

HISTORICAL NOTE

THE charter of Northwestern University was signed by the Governor of Illinois on January 28, 1851. The corporation consists of forty-four trustees. An amendment to the charter provides that no intoxicating liquors shall be sold within four miles of the University.

The trustees selected as the seat of the University a tract of land on the shore of Lake Michigan, twelve miles north from the heart of Chicago. Here in 1853 the first University building was erected and about its location has grown up the City of Evanston. Here are the College of Liberal Arts, the College of Engineering, the School of Music; the schools of Medicine, Law, Pharmacy, Dentistry and Commerce are located in the City of Chicago.

The College of Liberal Arts, the oldest department of the University, was opened to students in the fall of 1855. From its small beginning it has grown, not by rapid expansion or by large benefactions, but by steady gains along conservative lines—each of its fifty-four years adding some improvements to its physical and educational equipment. Its faculty numbers forty-five professors, twenty-three instructors and fourteen other officers giving instruction; its students number over one thousand. The work of the College of Liberal Arts is mainly directed toward furnishing opportunities for a liberal culture or general education. The regulations affecting the choice of studies are such that the student may elect a large part of his work along lines in which he is especially interested.

In recent years a demand for instruction in engineering gradually made itself felt. A gift for the erection of an engineering building at Evanston and for its endowment led the Trustees of the University to take action in June, 1907, resulting in the establishment of a College of Engineering. This gift came from Mrs. Gustavus F. Swift and her son, Edward F. Swift. The building, known as the Swift Hall of Engineering, was dedicated in May, 1909. It is now occupied by the College of Engineering. The Department of Mathematics of the College of Liberal Arts also has offices and recitation rooms in the building.

In the first year of its existence, 1909-10, the College of Engineering had a total registration of fifty-nine students.

STATEMENT OF PURPOSE

The purpose of the College of Engineering of Northwestern University is to furnish to each student a thorough training for the profession of engineering, combined with a general training of the man. The College aims to train engineers for the greatest average effectiveness in a lifetime rather than for the greatest effectiveness in the first year after graduation. It aims to develop a capacity for unlimited growth. Hence strong emphasis is laid on those studies which tend to develop the man as well as on those which furnish training in engineering.

In keeping with these ideals, the courses in engineering introduce an unusual number of those non-technical studies that serve to give a general education and to develop the thinking power of the student. Unusual stress is laid upon Mathematics, upon Physics and other sciences fundamental to engineering and upon the principles which are broadly applicable to all engineering. The courses are five years in length, because past experience among colleges of engineering shows that four years is too short a time for the thorough professional training contemplated. At the end of four years the student of engineering will have secured as thorough a general training as one who comes to Northwestern University for general training alone. In recognition of that fact, he will be given the degree of Bachelor of Science by the College of Liberal Arts. During the fifth year the general training of the student is continued and he completes his professional course in engineering.

The motto of the College is "Culture for Usefulness." This motto calls for an effort to obtain for the student the broadest culture attainable in five years in order to equip him, as a man and as an engineer, for the greatest possible usefulness in the world in the united struggle of man for progress.

REQUIREMENTS FOR ADMISSION

The requirements for admission to the College of Engineering of Northwestern University are the same as those for admission to the College of Liberal Arts.

Candidates for admission without entrance conditions must qualify by examination or by certificate on fifteen units of High School work. The unit is a course of study requiring a daily recitation on a prepared topic for a full school year, and covering in the various subjects the work defined in the University Catalogue, pp. 69-74. These definitions of units are the same as those adopted by the North Central Association of Colleges and Secondary Schools. Two hours of laboratory work are counted as the equivalent of one hour of prepared recitation.

The subjects which may be presented for admission credit and the number of units acceptable in each are shown in the following table. English, three units; Algebra, one and a half units; and Plane Geometry, one unit, are required of all candidates. A choice is allowed in the selection of other subjects, but at least four units of foreign languages must be presented. These may be four units of Latin, or three units of one language and one unit of another, or two units of each of two languages. A single unit of any language will be accepted only when accompanied by at least three units of some other language or two units each of two others. The remaining work may be selected at will from the subjects listed.

A candidate may be admitted to the College of Engineering as a regular student with not more than two units of condition, but entrance conditions, if any, must be made up during the first year of residence.

SUBJECTS WHICH MAY BE PRESENTED FOR ENTRANCE CREDIT

The first three subjects in the amounts indicated are required of all candidates.

English	3	units
Algebra	1½	units
Plane Geometry	1	unit

Latin	2, 3 or 4	units
Greek	2 or 3	units
German	2 or 3	units
French	2 or 3	units
Spanish	2	units
Advanced Algebra	½	unit
Plane Trigonometry	½	unit
Solid Geometry	½	unit
Physiography	1	unit
Physics	1	unit
Botany	1	unit
Zoology	1	unit
Chemistry	1	unit
Ancient History	1	unit
Mediæval and Modern History	1	unit
English History	1	unit
American History (or with Civil Government)	1	unit
Civil Government	½	unit
Political Economy	½	unit
Commercial Geography	½	unit
Commercial Law	½	unit
Physiology	½	unit
Subjects not specified	2	units

Under the heading "Subjects not Specified" may be presented such topics as Manual Training, Domestic Science, Mechanical Drawing, etc., at the discretion of the Board of Examiners. Subjects enumerated above as full units may be presented as half units, or may be presented in excess of the amounts stated, only under this heading and such credit will be thus limited to two units.

Each student in engineering who has not presented Solid Geometry for entrance will be required to take Solid Geometry, three hours for one semester, in the first year. As this will be an extra load to be carried, which will make it difficult for the student to keep up with his class, each candidate is advised to present this subject for entrance if possible.

Admission to the College of Engineering may be by certificate or by examination. Candidates for admission must be at least sixteen years of age. Graduates of accredited academies or high schools should obtain certificates of work done, showing the ground covered and the grade received in each study. These certificates should be sent to the Registrar, College of Engineering, at least one week before the opening of the fall semester. It is advisable to send them in much earlier. Certificate blanks may be had on request. Candidates who cannot present such certificates may be admitted on examination. Examinations for this purpose will be held September 19 and 20, 1910. The Board of Examiners will accept, in lieu of its examinations, those conducted by the College Entrance Examination Board. This Board holds examinations in June in the Northwestern University Building in Chicago, and at various other places in the United States.

COURSES OF STUDY

The College of Engineering offers two courses of study, each five years in length, one in Mechanical and Electrical Engineering and the other in Civil Engineering. These courses are alike in character and the same in content to the end of the third year.

For the satisfactory completion of either course a degree in engineering will be conferred by the College of Engineering. For the satisfactory completion of the first four years of either course, the degree of Bachelor of Science will be given by the College of Liberal Arts.

COURSE IN MECHANICAL AND ELECTRICAL ENGINEERING

First Year	Year hours
English Language A	3
French A*	3

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*The student is advised to take the required modern languages in the order indicated above if he has offered for entrance two units of

Physics A	4
Algebra, Trigonometry and Analytical Geometry, Mathematics A3	5
Mechanical Drawing, Engineering A1, to be taken as a two-hour course, either in the first or the second semester	1
Shop Work, Engineering A2, to be taken as a two-hour course, either in the second semester or the first semester	1

Second Year	Year hours
German A	3
Principles of Mechanics, Physics B	3
Differential and Integral Calculus, Mathematics B1	3
Chemistry A	4
Surveying, Engineering B2	3
Shop Work, Engineering B1	1

Third Year	Year hours
Elements of Economics, Economics A	3
Electricity and Magnetism, Physics C	3
Qualitative Analysis, Organic Chemistry, Chemistry B	4
Geology A1	4
Descriptive Geometry, Kinematics and Graphical Statics, Engineering C1	3

Fourth Year	Year hours
English Literature A	2
Elective	3
Structural Mechanics, Engineering D3	3
Advanced Calculus, Mathematics C1	3
Metallurgy, Geology B5, a two-hour course in the first semester only	1
Contracts and Specifications, Engineering D1, a two-hour course in the second semester only	1

French and two of German, but the order may be reversed. If other language units than those named in the preceding sentence have been offered for entrance, the student is required to take such language courses in the first and second years as will satisfy the language requirement for the degree of Bachelor of Science. These are not necessarily the courses French A and German A.

Journal Meeting, Engineering D2	1
Electrical Engineering, Engineering D6	3

Fifth Year

First Semester	Semester hours
Elective*	2
Thermodynamics, Engineering E1 (not offered in 1910-11)	4
Engines, Engineering E3 (not offered in 1910-11)	3
Hydraulic Engineering, Engineering E4 (not offered in 1910-11)	3
Advanced Electrical Engineering, Engineering E5	3
Thesis, Engineering E7 (not offered in 1910-11)	2

Second Semester	Semester hours
Elective*	2
The Public Relations of Engineers, Engineering E2 (not offered in 1910-11)	2
Engines, Engineering E3 (not offered in 1910-11)	3
Hydraulic Engineering, Engineering E4 (not offered in 1910-11)	3
Electrical Power Plant Engineering, Engineering E6	3
Thesis, Engineering E7 (not offered in 1910-11)	4

The course contains seventeen year hours in each year, exclusive of summer work.

During each of the three summers following the first, third and fourth years the student will be required to do practical work for at least six weeks, of such a character as to furnish experience of value to him as a prospective engineer. The credit assigned to six weeks of such approved work is two semester hours.

During the summer following the second year the student is required to do field work in surveying for six weeks immediately following Commencement (Engineering B2), credit six semester hours.

In 1909-10, the first year of existence of the College, there were no students in the fourth year of either course. Hence, none are expected in the fifth year of either course in 1910-11, and several of the fifth year studies are not offered.

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*This elective is to be approved by the Director and to be taken in the College of Liberal Arts.

COURSE IN CIVIL ENGINEERING

The first three years of this course are the same as those in the course in Mechanical and Electrical Engineering shown above.

Fourth Year	Year hours
English Literature A	2
Structural Mechanics, Engineering D3	3
Advanced Calculus, Mathematics C1	3
Elective in Geology	3
Metallurgy, Geology B5, a two-hour course in the first semester only	1
Contracts and Specifications, Engineering D1, a two-hour course in the second semester only	1
Journal Meeting, Engineering D2	1
Electrical Machinery, Engineering D5, a three-hour course in the first semester only	1½
Heat Engines, Engineering D4, a three-hour course in the second semester only	1½

Fifth Year

First Semester	Semester hours
Elective*	3
Bridges, Engineering E8 (not offered in 1910-11)	5
Railway Engineering, Engineering E10 (not offered in 1910-11)	4
Hydraulic Engineering, Engineering E4 (not offered in 1910-11).	3
Thesis, Engineering E7 (not offered in 1910-11)	2

Second Semester	Semester hours
Elective*	3
Structures, Engineering E9 (not offered in 1910-11)	~~3~~ 5
The Public Relations of Engineers, Engineering E2 (not offered in 1910-11)	2
Hydraulic Engineering, Engineering E4 (not offered in 1910-11)	3
Thesis, Engineering E7 (not offered in 1910-11)	4

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*This elective is to be approved by the Director and to be taken in the College of Liberal Arts.

The course contains seventeen year hours in each year, exclusive of summer work.

During each of the three summers following the first, third and fourth years the student will be required to do practical work for at least six weeks, of such a character as to furnish experience of value to him as a prospective engineer. The credit assigned to six weeks of such approved work is two semester hours.

During the summer following the second year the student is required to do field work in surveying for six weeks immediately following Commencement (Engineering B2), credit six semester hours.

Descriptions of such of the studies in the above courses as were given in 1909-10 are printed in the Annual Catalogue for 1909-10, pages 83-118.

ADMISSION TO ADVANCED STANDING

Students from other colleges seeking admission to this College must present evidence of honorable dismissal from the institution last attended and must present certificates showing the grades of credit for the subjects pursued elsewhere, with the number of weeks and the number of hours a week the respective studies were followed. Students from other colleges must meet the entrance requirements to this College. The amount of advanced credit to be obtained by certificate from another institution is determined by a committee of the Faculty, and is finally adjusted only after the student has been in residence in this College for one semester. Advanced credit without examination will be given only for work done in an approved college. Claims for advanced credit must be made during the first year of residence and not later than September of the collegiate year in which the candidate expects to graduate.

FIRST YEAR SCHOLARSHIPS

A few scholarships are awarded annually to select members of the incoming class, upon applications endorsed by the principal and faculty of the secondary school from which the applicant graduates. The applicant must meet the full entrance requirements and must present certificates from the teachers in his secondary school for excellence of character, physical vigor, manliness and promise of usefulness as a citizen. The award is made at the University by a committee of the College faculty.

OPPORTUNITIES FOR SELF-HELP

Many students in Evanston have been able, while in college, to earn the cost of their living in full, and every year a large percentage earn a considerable portion of their expenses, and at the same time maintain a high standing in their studies. It is never advisable, however, for a student to undertake more work of this kind than is necessary for his personal support, and, if the amount is excessive, he should plan to give more than the normal five years to his college course.

The General Secretary of the Young Men's Christian Association maintains a bureau to assist students in finding employment. The positions most frequently open to young men are those as waiters at boarding places or as attendants in private houses in the care of gardens or furnaces. While the aggregate of the annual earnings of students is a large sum, the number of positions open is limited and no assurances can be given that employment will be found. Only the most faithful and self-reliant students should undertake self-support, and in no case should a student come to Evanston without sufficient means to meet expenses for at least a half-year.

ATHLETICS, SOCIAL LIFE, ETC.

In athletics, in social life and in the use of the buildings, there is no separation of the students of Engineering from the students of Liberal Arts. Engineering students go to the various buildings of the College of Liberal Arts for recitations in other than strictly engineering subjects. They share in the use of the University Library. They have free access to the new gymnasium, the largest in the United States. Their social life is mingled with that of the Liberal Arts students in one university group.

SOME ADVANTAGES OF THE COLLEGE OF ENGINEERING AT NORTHWESTERN UNIVERSITY

It offers a thorough professional course rather than a purely practical course. It places the emphasis on the fundamentals which are common to all branches of engineering. It trains its graduates for unlimited growth as engineers and for possible leadership.

The engineering courses, five years in length, are so arranged as to give each man his general broad training at the same time that he pursues his engineering studies. The Engineering students are closely associated with the larger group of Liberal Arts students, of which they, in fact, form a part.

In the purely engineering part of the course, the proportion of professors to students is much larger than is customary and each student, therefore, receives an unusual amount of attention.

There is more engineering in progress within fifty miles of the loop district of Chicago than in any area of the same size anywhere in the United States with the possible exception of New York City. The students of this College thus have an unsurpassed opportunity to keep in touch with engineering practice and to meet engineers.

The College of Engineering is a new organization not hampered by traditions ,and is thus in an excellent condition to take advantage of the experience of other colleges in training engineers.

It is provided with new equipment and with a new excellent building of ample size to meet present requirements.

Inquiries for further information, requests for the catalogue of the University and for scholarship application blanks and blank forms of certificates from secondary schools may be addressed to the Director, College of Engineering, Northwestern University, Evanston, Ill.

FEES AND EXPENSES.

Matriculation Fee, paid on first registration	$ 5.00
Tuition Fee, a year	100.00
Payable one-half at the beginning of the first semester, one-half at the beginning of the second.	
Laboratory Fees:	
Courses A1, C1, D4, D6, E5, and E6, each course, a semester	3.00
Courses A2 and B1, each, a semester	4.00
Courses B2 and D3, each, a semester	5.00
Fee for summer course in surveying, B3	30.00
Diploma Fee	10.00

Reduced rates of tuition are given to sons of ministers ($30.00 per semester) and to holders of old-time perpetual or transferable scholarships for incidentals ($22.00 per semester).

The remaining necessary expenses of a student, namely, board, room, laundry, text-books and stationery, for nine months, varies from $200 to $370, the average being about $270.

Northwestern University

¶ THE COLLEGE OF LIBERAL ARTS, located at Evanston, in an ideal college community, offers special preparation for the professions, and for pursuits requiring broad training.

¶ THE MEDICAL SCHOOL is one of the oldest, largest, and best equipped. Seven hospitals are open to students. Clinic material is abundant.

¶ THE LAW SCHOOL, the oldest law school in Chicago, offers unexcelled library facilities and special courses that prepare for immediate practice in any state upon graduation.

¶ THE COLLEGE OF ENGINEERING has its own building just completed, beautifully situated, a model of efficiency. Offers courses in all branches of Engineering. Technical studies in a University environment.

¶ THE SCHOOL OF PHARMACY offers a scientific training in Pharmacy, Chemistry, and Drug and Food Analysis. Special courses for Drug Clerks.

¶ THE DENTAL SCHOOL offers expert training in theory and practice. Facilities are unsurpassed. Its clinic is the largest in the world.

¶ THE SCHOOL OF MUSIC affords a scientific preparation for music as an accomplishment and a profession. It is located at Evanston.

¶ THE SCHOOL OF COMMERCE provides instruction in economics, elementary and corporation finance, commercial law and accounting. Many lecturers from business and professional life.

¶ EVANSTON ACADEMY prepares for college, for engineering, for professional schools, and for business.

University Directory

ABRAM WINEGARDNER HARRIS
Sc. D., LL. D., President

Special announcements of the several departments of the University may be had on application. Address inquiries to the following:

COLLEGE OF LIBERAL ARTS the Registrar
University Hall, Evanston, Illinois

MEDICAL SCHOOL the Secretary
2421-2437 Dearborn Street, Chicago

LAW SCHOOL the Secretary
Northwestern University Building, Chicago

SCHOOL OF PHARMACY the Secretary
Northwestern University Building, Chicago

DENTAL SCHOOL the Secretary
Northwestern University Building, Chicago

SCHOOL OF MUSIC the Secretary
Music Hall, Evanston, Illinois

COLLEGE OF ENGINEERING the Registrar
Swift Hall of Engineering, Evanston, Illinois

SCHOOL OF COMMERCE the Secretary
Northwestern University Building, Chicago

EVANSTON ACADEMY Evanston, Illinois
Nathan Wilbur Helm, A. M., Principal

GRAND PRAIRIE SEMINARY, Onarga, Illinois
Henry Hoag Frost, A. B., President

ELGIN ACADEMY Elgin, Illinois
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Northwestern University Bulletin

COLLEGE OF ENGINEERING ANNOUNCEMENTS

1911-1912

1851

EVANSTON, ILLINOIS

NORTHWESTERN UNIVERSITY

Special Advantages of the New College of Engineering

A thorough professional course rather than a purely practical one, with five years of broad training.

Small classes in which each student receives an unusual amount of individual attention.

A splendid new building designed for the purpose, with entirely new apparatus.

Accessibility to great engineering projects, with unsurpassed opportunities to meet engineers and keep in touch with engineering practice.

A new organization unhampered by embarrassing traditions.

Northwestern University Bulletin

COLLEGE OF ENGINEERING ANNOUNCEMENTS 1911-1912

Volume XI, Number 30

Evanston
Published by the University
April, 1911

SWIFT HALL OF ENGINEERING

Swift Hall of Engineering, the gift of Mrs. Gustavus F. Swift and her son, Edward F. Swift, was dedicated in 1909. The building measures fifty-eight by one hundred and twenty-six feet; the exterior is of Bedford limestone and presents architectural lines that are of the best; the interior is a model of appropriate decoration, convenience, safety and strength; it has concrete floors and stairways throughout. It presents five working stories, all well lighted and of good height, while the large rooms at the ends of the building are free from columns. From the beginning it was especially planned as the home of the College of Engineering, in a delightful location overlooking Lake Michigan.

The College of Engineering

Abram Winegardner Harris, Sc.D., LL.D.
President

John Fillmore Hayford, C.E.
Director

Olin Hanson Basquin, Ph.D.
Professor of Applied Mechanics

William Charles Bauer, B.S.
Professor of Electrical Engineering

William Henry Burger, B.S.
Assistant Professor of Civil Engineering

Milby Roy Hammer, B.S.
Assistant Professor of Drawing

James Taft Hatfield, Ph.D.
Professor of German Language and Literature

Henry Crew, Ph.D.
Professor of Physics

J. Scott Clark, A.M., Litt.D.
Professor of English Language

Edouard Paul Baillot, L.H.D.
Professor of Romance Languages

Ulysses Sherman Grant, Ph.D.
Professor of Geology

Arthur Charles Lewis Brown, Ph.D.
Professor of English Literature

Willard Eugene Hotchkiss, Ph.D.
Professor of Economics

David Raymond Curtiss, Ph.D.
Professor of Mathematics

Walter Lichtenstein, Ph.D.
Librarian

Robert Richardson Tatnall, Ph.D.
Associate Professor of Physics

Murray Arnold Hines, Ph.D.
Assistant Professor of Chemistry

David Harrison Stevens, A.B.
Registrar

Mabel Harriet Siller, B.L.
Assistant Registrar

Andrews Allen, C.E.
Lecturer on Contracts and Specifications

Elmer Martin Liessmann, LL.B.
Lecturer on Contracts and Specifications

George Ernest Stanford
Shop Assistant

Calendar

1911-1912

1911	
Sept. 25, Mon.	Academic year 1911-12 begins; examinations for admission; first day of registration
Sept. 27, Wed.	Second examinations
Sept. 28, Thu.	Class work begins
Nov. 30, Thu.	Thanksgiving Recess, to December 3, Sunday, inclusive
Dec. 22, Fri.	Christmas Recess, to January 2, Tuesday, inclusive
1912	
Jan. 3, Wed.	Class work resumed
Jan. 27, Sat.	Qualifying examinations
Jan. 31, Wed.	Mid-year examinations begin
Feb. 9, Fri.	Second semester begins
Feb. 10, Sat.	Second examinations
Feb. 12, Mon.	Class work resumed
Feb. 22, Thu.	Washington's Birthday
Apr. 5, Fri.	Easter Recess, to April 8, Monday, inclusive
Apr. 8, Mon.	Second examinations
May 25, Sat.	Qualifying examinations
May 29, Wed.	Regular examinations begin
May 30, Thu.	Memorial Day
June 12, Wed.	FIFTY-FOURTH ANNUAL COMMENCEMENT
June 10, Mon.	Beginning of summer surveying
July 20, Sat.	End of summer surveying

Historical Note

THE charter of Northwestern University was signed by the Governor of Illinois on January 28, 1851. The corporation consists of forty-four trustees. An amendment to the charter provides that no intoxicating liquors shall be sold within four miles of the University.

The trustees selected as the seat of the University a tract of land on the shore of Lake Michigan, twelve miles north from the heart of Chicago. Here in 1853 the first University building was erected and about its location has grown up the City of Evanston. Here are the College of Liberal Arts, the College of Engineering, the School of Music; the schools of Medicine, Law, Pharmacy, Dentistry and Commerce are located in the City of Chicago.

The College of Liberal Arts, the oldest department of the University, was opened to students in the fall of 1855. From its small beginning it has grown, not by rapid expansion or by large benefactions, but by steady gains along conservative lines—each of its fifty-five years adding some improvements to its physical and educational equipment. Its faculty numbers forty-four professors, twenty-two instructors and fifteen other officers giving instruction; its students number over one thousand. The work of the College of Liberal Arts is mainly directed toward furnishing opportunities for a liberal culture or general education. The regulations affecting the choice of studies are such that the student may elect a large part of his work along lines in which he is especially interested.

In recent years a demand for instruction in engineering gradually made itself felt. A gift for the erection of an engineering building at Evanston and for its endowment led the Trustees of the University to take action in June, 1907, resulting in the establishment of a College of Engineering. This gift came from Mrs. Gustavus F. Swift and her son, Edward F. Swift. The building, known as the Swift Hall of Engineering, was dedicated in May, 1909. It is now occupied by the College of Engineering. The Department of Mathematics of the College of Liberal Arts also has offices and recitation rooms in the building.

In the first year of its existence, 1909-10, the College of Engineering had a total registration of fifty-nine students.

STATEMENT OF PURPOSE

The purpose of the College of Engineering of Northwestern University is to furnish to each student a thorough training for the profession of engineering, combined with a general training of the man. The College aims to train engineers for the greatest average effectiveness in a lifetime rather than for the greatest effectiveness in the first year after graduation. It aims to develop a capacity for unlimited growth. Hence strong emphasis is laid on those studies which tend to develop the man as well as on those which furnish training in engineering.

In keeping with these ideals, the courses in engineering introduce an unusual number of those non-technical studies that serve to give a general education and to develop the thinking power of the student. Unusual stress is laid upon Mathematics, upon Physics and other sciences fundamental to engineering and upon the principles which are broadly applicable to all engineering. The courses are five years in length, because past experience among colleges of engineering shows that four years is too short a time for the thorough professional training contemplated. At the end of four years the student of engineering will have secured as thorough a general training as one who comes to Northwestern University for general training alone. In recognition of that fact, he will be given the degree of Bachelor of Science by the College of Liberal Arts. During the fifth year the general training of the student is continued and he completes his professional course in engineering.

The motto of the College is "Culture for Usefulness." This motto calls for an effort to obtain for the student the broadest culture attainable in five years in order to equip him, as a man and as an engineer, for the greatest possible usefulness in the world in the united struggle of man for progress.

Requirements for Admission

The requirements for admission to the College of Engineering of Northwestern University are the same as those for admission to the College of Liberal Arts.

Candidates for admission without entrance conditions must qualify by examination or by certificate on fifteen units of High School work. The unit is a course of study requiring a daily recitation on a prepared topic for a full school year, and covering in the various subjects the work defined in the University Catalogue. These definitions of units are the same as those adopted by the North Central Association of Colleges and Secondary Schools. Two hours of laboratory work are counted as the equivalent of one hour of prepared recitation.

The subjects which may be presented for admission credit and the number of units acceptable in each are shown in the following table. English, three units; Algebra, one and a half units; and Plane Geometry, one unit, are required of all candidates. A choice is allowed in the selection of other subjects, but at least four units of foreign languages must be presented. These may be four units of Latin, or three units of one language and one unit of another, or two units of each of two languages. A single unit of any language will be accepted only when accompanied by at least three units of some other language or two units each of two others. The remaining work may be selected at will from the subjects listed.

A candidate may be admitted to the College of Engineering as a regular student with not more than two units of condition, but entrance conditions, if any, must be made up during the first year of residence.

SUBJECTS WHICH MAY BE PRESENTED FOR ENTRANCE CREDIT

The first three subjects in the amounts indicated are required of all candidates.

English	3	units	German	2 or 3	units
Algebra	1½	units	French	2 or 3	units
Plane Geometry	1	unit	Spanish	2	units
Latin	2, 3 or 4	units	Advanced Algebra	½	unit
Greek	2 or 3	units	Plane Trigonometry	½	unit

Solid Geometry	½	unit
Physiography	1	unit
Physics	1	unit
Botany	1	unit
Zoology	1	unit
Chemistry	1	unit
Ancient History	1	unit
Mediæval and Modern History	1	unit
English History	1	unit
American History (or with Civil Government)	1	unit
Civil Government	½	unit
Political Economy	½	unit
Commercial Geography	½	unit
Commercial Law	½	unit
Physiology	½	unit
Subjects not specified	2	units

Under the heading "Subjects not Specified" may be presented such topics as Manual Training, Domestic Science, Mechanical Drawing, etc., at the discretion of the Board of Examiners. Subjects enumerated above as full units may be presented as half units, or may be presented in excess of the amounts stated, only under this heading and such credit will be thus limited to two units.

Each student in engineering who has not presented Solid Geometry for entrance will be required to take Solid Geometry, three hours for one semester, in the first year. As this will be an extra task, making it difficult for the student to keep up with his class, each candidate is advised to present this subject for entrance if possible.

Admission to the College of Engineering may be by certificate or by examination. Candidates for admission must be at least sixteen years of age. Graduates of accredited academies or high schools should obtain certificates of work done, showing the ground covered and the grade received in each study. These certificates should be sent to the Registrar, College of Engineering, at least one week before the opening of the fall semester. It is advisable to send them in much earlier. Certificate blanks may be had on request. Candidates who cannot present such certificates may be admitted on examination. Examinations for this purpose will be held September 25, 1911. The Board of Examiners will accept, in lieu of its examinations, those conducted by the College Entrance Examination Board. This Board holds examinations in June in the Northwestern University Building in Chicago, and at various other places in the United States.

Courses of Study

The College of Engineering offers two courses of study, each five years in length, one in Mechanical and Electrical Engineering and the other in Civil Engineering. These courses are alike in character and the same in content to the end of the third year.

For the satisfactory completion of the first four years of either course, the degree, Bachelor of Science, will be given by the College of Liberal Arts.

The degree, Electrical Engineer, will be given by the College of Engineering at the end of the five-year course in Mechanical and Electrical Engineering, and the degree, Civil Engineer, at the end of the five-year course in Civil Engineering.

COURSE IN MECHANICAL AND ELECTRICAL ENGINEERING

	Semester Hours	
	First	Second
Freshman Year	Semester	Semester
English Language A	3	3
French A	3	3
Physics A	4	4
Mathematics A3	5	5
Drawing, Engineering A1, or Shop, Engineering A2	2	..
Drawing, Engineering A1, or Shop, Engineering A2	..	2
Summer Work	..	2

	Semester Hours	
	First	Second
Sophomore Year	Semester	Semester
German A	3	3
Physics B1	3	3
Calculus, Mathematics B1	3	3
Chemistry A	4	4
Surveying, Engineering B2	3	3
Shop, Engineering B1	1	1
Summer Surveying, Engineering B3	..	6

	Semester Hours	
Junior Year	First Semester	Second Semester
Economics A	3	3
Physics C	3	3
Chemistry B	4	4
Geology A1	4	4
Descriptive Geometry, Kinematics, and Graphical Statics, Engineering C1	3	3
Summer Work	..	2

	Semester Hours	
Senior Year	First Semester	Second Semester
English Literature A	2	2
Mechanics, Engineering D3	3	3
Calculus, Mathematics C1	3	3
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Electrical Engineering, Engineering D6	3	3
Elective	3	3
Summer Work	..	2

	Semester Hours	
Fifth Year	First Semester	Second Semester
Hydraulic Engineering, Engineering E4	3	3
Thermodynamics, Engineering E1	4	..
The Public Relations of Engineers, Engineering E2	..	2
Thesis, Engineering E7	2	4
Engines, Engineering E3	3	3
Advanced Electrical Engineering, Engineering E5	3	..
Power Plant Engineering, Engineering E6	..	3
Elective	2	2

COURSE IN CIVIL ENGINEERING

The first three years of this course are the same as those in the course in Mechanical and Electrical Engineering shown above.

Senior Year	Semester Hours First Semester	 Second Semester
English Literature A	2	2
Mechanics, Engineering D3	3	3
Calculus, Mathematics C1	3	3
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Electrical Machinery, Engineering D5	3	..
Heat Engines, Engineering D4	..	3
Elective, Geology	3	3
Summer Work	..	2

Fifth Year	Semester Hours First Semester	 Second Semester
Hydraulic Engineering, Engineering E4	3	3
Railroad Engineering, Engineering E10	4	..
The Public Relations of Engineers, Engineering E2	..	2
Thesis, Engineering E7	2	4
Bridges, Engineering E8	5	..
Structures, Engineering E9	..	5
Elective	3	3

Each course contains seventeen semester hours of credit each semester, exclusive of summer work.

For recitations or lectures one semester hour of credit is given for one period, fifty minutes, each week during one semester. For shop work, drafting or laboratory work one semester hour of credit is given for one three-hour period each week during one semester.

During each of the three summers following the first, third and fourth years the student is required to do practical work for at least six weeks, of such a character as to furnish experience of value to him as a prospective engineer. The credit assigned to six weeks of such approved work is two semester hours.

In the summer of 1910, under this requirement, students acted as rodmen on city surveys, rodmen on the United States Lake Survey, workers in the tool room of a factory, helpers in the installation of heavy machinery in a new steam-electric power plant, foreman of a gang of laborers, helpers in the wiring of telephone switchboards, and inspectors with a company engaged in electric lighting and power distribution.

During the summer following the second year the student is required to do field work in surveying for six weeks immediately following examinations, Engineering B3, credit six semester hours. This is a regular college course under the direction of college professors, taken at a summer camp established for that purpose.

All of the courses indicated above are offered in 1911-12 except the Engineering courses D4, D5, E8, E9 and E10. No students at present in the College of Engineering will be ready for these omitted courses in 1911-12.

The following paragraphs give more specific information in regard to the separate courses enumerated above as together constituting the courses in Mechanical and Electrical Engineering and in Civil Engineering:

English Language A. Rhetoric; Synonyms; Eight Essays—First semester. Drill in the elements of good style. Second semester. Rhetorical imagery and synonyms. Students who show, early in the semester, that they are seriously deficient in elementary English, are required to take additional work for such time as may be found necessary. This course is required of all students during the first year of residence. Three semester hours throughout the year.

French A. Modern French—Baillot-Brugnot's Composition. Advanced Grammar. Reading. Madame de Girardin's La Joie fait Peur. Eugène Scribe's Les Doigts de Fée. Coppée's On rend l'Argent. Freeborn's Contes de Daudet. Pailleron's Le Monde où l'on s'Ennuie. White's Contes de Maupassant. Victor Hugo's Quatre-Vingt Treize. Canfield's French Lyrics. Coppée's Le Pater.

Victor Hugo's Hernani. Private reading: Cameron's Selections from Loti. Hennequin's Lessons in Idiomatic French. Essays. Three semester hours throughout the year. Open to students who present two units of French for entrance. If the student has presented no French for entrance he must take French AA, five semester hours throughout one year, in college before being admitted to French A, or if he has presented one unit of French for entrance he must ordinarily take French AB, three semester hours throughout one year, in college before being admitted to French A.

German A. Intermediate German—Some sections take modern prose writers, Storm, Freytag, Seidel, Ernst, etc. German lyrics and ballads, Goethe's Hermann und Dorothea. Other sections take Lessing's Minna von Barnhelm, Goethe's lyrics and ballads, Schiller's Wilhelm Tell and Maria Stuart, Goethe's Hermann und Dorothea. Three semester hours throughout the year. If the student has presented no German for entrance he must take Germann AA, five semester hours throughout one year, in college before being admitted to German A, or if he has presented one unit of German for entrance he must ordinarily take German AB, three semester hours throughout one year, in college before being admitted to German A.

If the student has offered for entrance two units of French and two of German he is advised to take French A in the first year and German A in the second year, but the order may be reversed. If other language units than those named in the preceding sentence have been offered for entrance, the student is required to take such language courses in the first and second years as will satisfy the language requirement for the degree of Bachelor of Science. These are not necessarily the courses French A and German A. For example, if a student has presented two or three units of Latin or of Greek for entrance he may be released, both as to entrance credits and to college work, from a part of French or German. For complete information on this point consult the statement of prescribed courses for the degree of Bachelor of Science in the University catalogue.

Mathematics A3. Plane Trigonometry, Algebra and Analytical Geometry—This is a course in which Plane Trigonometry, Algebra, Analytical Geometry and some of the elements of Differential Calculus are given together in one continuous course. Open to all students. Five semester hours throughout the year.

If a student has presented College Algebra or Plane Trigonometry for entrance, instead of taking Mathematics A3 in the freshman year, he is required to take three semester hours in each of two semesters in courses known as Mathematics A1 and Mathematics A2, so arranged that with the work offered for entrance they will be equivalent to Mathematics A3.

Mathematics B1. Differential and Integral Calculus—One section of the class continues the work of Mathematics A3, including Calculus and an introduction to Solid Analytical Geometry. Another section continues the work of Mathematics A1 and A2. Three semester hours throughout the year.

Mathematics C1. Advanced Calculus—Infinite series; Taylor's theorem; partial differentiation; differential geometry; definite integrals over curves, surfaces and volumes; the Eulerian functions; Fourier's series; differential equations. Open to students who have completed Mathematics B1. Three semester hours throughout the year.

Physics A. General Physics—First semester—General properties of matter, wave-motion, sound. Second semester—Heat, electricity, magnetism, light. An introductory course requiring no mathematics beyond the requirements for entrance to college, intended to acquaint the student with the elementary facts, the method, and the general principles of physical science. Text-book: Crew's General Physics. Three lectures and one laboratory exercise each week. Four semester hours throughout the year.

Physics B1. Mechanics—An elementary experimental study of forces, moments of force, moments of inertia, elasticity, hydromechanics, an introduction to advanced Physics and Engineering. This is a course in pure Dynamics, and serves as an introduction to Applied Mechanics. Text-book: Crew's Principles of Mechanics. Two lectures and one laboratory exercise each week. The laboratory work is guided by especially prepared instructions. Open to students who have completed Physics A, or its equivalent. Three semester hours throughout the year.

Physics C. Electricity and Magnetism, The Direct Current Circuit—The more general laws of electricity and magnetism are discussed; the practical equations employed in the laboratory are derived and discussed. Text-book: J. J. Thomson's Elements of the Mathematical Theory of Electricity and Magnetism. The laboratory work includes the measurement by one or more methods of current, resistance, electromotive force, temperature-coefficients, capacity; a study of the magnetic properties of iron and steel, thermoelectric effects, the use of the electrometer, the Carey Foster bridge, potentiometer, copper voltameter, etc. Open to students who have completed Physics A. Two lectures and one laboratory exercise each week. Three semester hours throughout the year.

Chemistry A. General Chemistry, Elementary—Text and laboratory work. Open to all students. In certain sections the course is arranged for students who have offered one unit of Chemistry for entrance and in other sections for those who have offered none. Four semester hours throughout the year.

Chemistry B. Qualitative Analysis; Organic Chemistry—Lectures, recitations, and laboratory work. Open to students who have completed Chemistry A or its equivalent. Four semester hours throughout the year.

Geology A1. General Geology—A general introduction to Geology. Lectures, recitations and laboratory work. Open to students who have thirty semester hours of credit and who have completed in college or in high school a year-course in Chemistry. Four semester hours throughout the year.

Geology B5. Metallurgy—Fuels, refractory materials, metallurgy of iron and steel. Open to those students of Engineering who have completed Chemistry A and Chemistry B. Two semester hours in the first semester only.

Economics A. The Elements of Economics—An elementary course in economic theory. The first semester is devoted to the fundamental principles of value. In the second semester these principles are applied to practical economic problems. The work of the second semester varies in the different sections according to the instructor's individual choice. Open to students who have thirty semester hours of credit. Three semester hours throughout the year.

English Literature A. General View of English Literature—A general outline of the development of English literature. Lectures, recitations and a considerable amount of reading. Open to students who have thirty semester hours of credit. Two semester hours throughout the year.

Electives—Six semester hours of electives are provided for in the senior year of the Mechanical and Electrical Engineering course and four in the fifth year. In the fifth year of the Civil Engineering course six hours of electives are required. These electives are limited to courses given in the College of Liberal Arts, the choice to be approved by the Director.

Elective in Geology.—Six hours of elective work limited to the courses in Geology given in the College of Liberal Arts, are required in the senior year of the Civil Engineering course.

Engineering A1. Mechanical Drawing—An elementary course in the technique of mechanical drawing, requiring no previous knowledge of drawing. Freehand lettering, exercise drawing, freehand sketching, shop drawing in pencil, tracing in ink on tracing cloth, machine sketching, isometric and cabinet drawing. Open to all students. Two afternoons a week. Two semester hours for one semester, to be taken in either semester.

Engineering A2. Freshman Shop Work—A series of elementary practical exercises in the shop, upon a wide variety of subjects, the object being to bring out the principles involved, to acquaint the student with a considerable range of mechanical experience and to cultivate habits both of logical thinking and of accurate work. The exercises involve some wood turning, pattern making, filing, scraping, sawing, punching, riveting, brazing, metal turning, shaping, planing, milling, grinding, etc. These exercises are guided by blue-printed instructions and by half hour talks on mechanical principles and processes, with occasional written work. Open to all students. Two afternoons a week. Two semester hours for one semester, to be taken in either semester.

Ordinarily it is expected that an engineering student will take

Engineering A1 in one semester and Engineering A2 in the other semester of his freshman year.

Engineering B1. Sophomore Shop Work—This is a more intensive course than Engineering A2, limited mainly to machine work and tool making. The work is upon problems rather than exercises, and in them the student is given an opportunity to show his ingenuity and his grasp of the subject; while his work is directed in a general way, he is not given detailed instructions. The objects made are generally parts of some machine tool; this emphasizes the need for accuracy and gives a practical turn and interest to the subject. The work naturally introduces the student to a somewhat advanced knowledge of machines and processes. Open to students who have completed Engineering A2. One afternoon each week. One semester hour throughout the year.

Engineering B2. Surveying—The use of chains, tapes, compass, level, transit, and plane table; methods of land, topographic and hydrographic surveying, including stream measurement, mine surveying and city surveying. Text-book: Theory and Practice of Surveying, by J. B. Johnson and L. S. Smith. Open to students who have completed Engineering A1 and Mathematics A3. Two recitations and one half day in the field each week. Three semester hours throughout the year.

Engineering B3. Summer Surveying—Applications under actual field conditions of the theory taught in Engineering B2. The outcome of the work will be a map of the region covered by the survey and much allied information. A new area will be covered each year, ordinarily adjacent to the area surveyed in the preceding year. The survey camp in 1911 will be established in the Fox Lake region in Illinois, near Antioch. Six weeks immediately following examinations. Open to students who have completed Engineering B2. Credit six semester hours.

Engineering C1. Descriptive Geometry, Kinematics and Graphical Statics—The course is divided into three equal parts. (1) Descriptive Geometry; first principles; point, line and plane; curved lines and surfaces; plane sections and developments; intersections of surfaces. Text-book, Essentials of Descriptive Geometry by Phillips and Millar.

(2) Kinematics: elementary propositions; communication of motion by rolling and sliding contact, by link work, by wrapping connectors; trains of mechanism; aggregate combinations. Text-book, Elementary Mechanism by Stahl and Woods. (3) Graphical Statics: general principles; concurrent and non-concurrent forces; moments; center of gravity of areas; moment of inertia; roof trusses; loads; reactions; stresses; wind load stresses; cantilever and unsymmetrical trusses; counterbracing; three-hinged arch; transverse bent. Text, Graphical Statics, by Malcolm. Open to students who have completed Engineering A1 and Mathematics A3. One recitation period and two half days of drawing each week. Three semester hours throughout the year.

Engineering D1. Contracts and Specifications—The course deals with contracts and specifications as applied to engineering only. Recitations and lectures. Text-book: Wait's Law of Contracts. Open to students who have sixty hours of credit. Two semester hours in the second semester only.

Engineering D2. Journal Meeting—The time is spent in reading and reviewing current engineering literature, the object being to acquaint the student with this fund of information, to show him the necessity of judicious selection from the great mass of such current literature, to indicate methods of selection, and to cultivate a habit of accurate reading. Open to students who have taken or who are taking Engineering D3, D4, D5 or D6. One afternoon each week. One semester hour throughout the year.

Engineering D3. Structural Mechanics—The text-book work is upon the application of mechanics to the elementary parts of structures, taking up properties of materials, testing materials, elementary theory of elasticity, stresses and strains of beams, columns, shafts, tubes, curved bars, springs and bodies in rapid rotation; stability of piles and retaining walls; elementary theory of reinforced concrete. The laboratory work relates partly to standard methods of testing materials such as steel and cement, but it is largely involved in an effort to bring to the clear comprehension of the student the various relations deduced in the text-book work upon the subject. Text-book: Morley's Strength of Materials. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering D4 and D5—Courses not given in 1911-12.

Engineering D6. Electrical Engineering—First semester—A general study of the fundamental principles of Electrical Engineering and their applications to direct current machinery. A selected series of problems are assigned to illustrate quantitatively the principles involved. Texts: Elements of Electrical Engineering, Direct Currents—Franklin and Esty; Principles of Electrical Engineering—Pender; Problems in Electrical Engineering—Lyon; and special laboratory instructions. Second semester—A general study of the fundamental principles of single and polyphase alternating currents, with special reference to analytic, graphic and symbolic methods of treatment. Elementary analysis of alternating current machinery. Texts: Elements of Electrical Engineering, Alternating Currents—Franklin and Esty; other texts as above and special laboratory instructions. Open to students who have completed Physics C and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E1. Thermodynamics—The course will consist of text-book work first upon the general theory of thermodynamics, and later upon its application to heat engines, taking up properties of gases, flow of gases, thermodynamics of air engines, internal combustion engines and air compressors, properties of steam and other vapors, thermodynamics of steam engines and steam turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Four semester hours in the first semester only.

Engineering E2. The Public Relations of Engineers—A course of lectures and reading dealing with the relations of a practicing engineer to other men. It will deal in part with biographies of engineers, the history of engineering, the purpose of organization and the conservation of natural resources. Open to students who have taken or who are taking Engineering E1, E3, E4, E5 or E6. Two semester hours in the second semester only.

Engineering E3. Engines—A detailed study of the steam engine, steam turbine, boiler plant equipment, gas engines and producer gas plants. Open to students who have taken or who are taking Engineering E1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E4. Hydraulic Engineering—The theory and application of the principles of hydrostatics and hydrodynamics; measurements of flow by pressure gages, meters, Pitot tubes and wiers; path, energy and impulse of jets; flow through orifices, tubes and pipes with loss of energy or head due to contractions, expansions and nozzles; derivation and application of formulæ for discharge, velocity and pressure; work derived from moving vanes as in water wheels and turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E5. Advanced Electrical Engineering—Advanced analysis by graphic and symbolic methods of alternating and direct current machinery. Lectures and the following reference texts: Alternating Current Motors—McAllister; the works of Steinmetz, and special laboratory instructions. Open to students who have completed Engineering D6. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering E6. Power Plant Engineering—A special study of generation, transmission and utilization of electrical energy, and electrical designing. Lectures and the following reference texts: Electrical Energy—Berg; Electric Power Plant Engineering—Weingreen; Dynamo Design—S. P. Thompson, and special laboratory instructions. Open to students who have completed Engineering E5. Two recitations and one laboratory period each week. Three semester hours in the second semester only.

Engineering E7. Thesis—Open to students in the last year in the Engineering course. Two semester hours in the first and four in the second semester.

Engineering E8, E9 and E10—Courses not given in 1911-12.

Advanced Standing

Students from other colleges seeking admission to this college must present evidence of honorable dismissal from the institution last attended and must present certificates showing (1) a full record of the applicant's preparation for college, (2) his college record, subject by subject, with the grade obtained in each subject and the year of the course in which it was taken. He should submit a catalogue of his college, bearing his name, and of the issue current at the time of his admission to that college. Students from other colleges must first meet the entrance requirements to this college, after which the amount of advanced credit to be obtained by certificate will be estimated by a committee of the Faculty, but not finally placed to his credit until the student has been in residence in this college for one semester. Advanced credit without examination will be given only for work done in an approved college. Claims for advanced credit must be made during the first year of residence and not later than September of the collegiate year in which the candidate expects to graduate.

College credit for work done in a secondary school in excess of the requirements for admission can be given only on examination provided through the Registrar's office, and on the basis of five semester hours of credit for one unit of work. An exception to the examination rule is made in foreign language subjects continued in college during the first year, where the subsequent work is a sufficient test of the quality of the earlier work. Applications for such credit and for examination must be made to the Registrar during the first semester of residence and the examination must be taken at one of the regular dates set, viz.: the Wednesday of the opening week in September, the Saturday following regular examinations in February, or the Monday following Easter. Advanced credit can be allowed only in Mathematics, foreign languages, or such other subjects taken in the last year of the secondary school course as may be approved by the Committee on Advanced Standing. No examination for advanced credit will be allowed after the first year of residence nor in subjects foreign to the college curriculum.

First Year Scholarships

A few scholarships are awarded annually to select members of the incoming class, upon applications endorsed by the principal and faculty of the secondary school from which the applicant graduates. The applicant must meet the full entrance requirements and must present certificates from the teachers in his secondary school for excellence of character, physical vigor, manliness and promise of usefulness as a citizen. The award is made at the University by a committee of the College faculty.

Fees and Expenses

Matriculation Fee, paid on first registration	$ 5.00
Tuition Fee, a year	100.00

Payable one-half at the beginning of the first semester, one-half at the beginning of the second.

Laboratory Fees

Chemistry A	$ 7.50	a semester
Chemistry B	9.00	a semester
Geology A1	2.00	a semester
Physics A or B1	2.00	a semester
Physics C	3.00	a semester
Engineering A1	6.00	a semester
Engineering A2	8.00	a semester
Engineering B1	4.00	a semester
Engineering B2 or D3	5.00	a semester
Engineering C1, D4, D5, D6, E5 or E6	3.00	a semester
Fee for summer surveying course, Engineering B3	15.00	
Diploma Fee	10.00	

The fees for the courses, Engineering E3 and E4, have not yet been fixed.

The laboratory fees for engineering courses are intended to cover ordinary depreciation of apparatus and the use of materials. The student is held responsible for any damage due to his negligence.

Laboratory fees are not refunded if the student continues in a course as long as two weeks, except that in the Chemical Laboratory the fee is in the nature of a deposit, where an account is kept of the material used and the unexpended balances, at the end of the year, are returned to the student.

The tuition fees will not be refunded except in case of sickness. If a student withdraws before the middle of the semester, on account of serious illness, one-half of his tuition fee will be refunded, on his obtaining from the Director a statement of honorable standing, and from a physician a certificate that his health will not permit him to remain in attendance.

Reduced rates of tuition are given to sons of clergymen who are actively pursuing the work of the ministry ($30.00 per semester) and to holders of old-time perpetual or transferable scholarships for incidentals ($22.00 per semester).

The remaining necessary expenses of a student, namely, board, room, laundry, text-books and stationery, for nine months, vary from $200 to $370, the average being about $270.

Students find comfortable homes in private families or live in clubhouses under their own management. Clubs are formed in which the cost of table board is reduced to a minimum.

OPPORTUNITIES FOR SELF-HELP

Some students in Evanston have been able, while in college, to earn the cost of their living in full, and every year a large percentage earn a considerable portion of their expenses, and at the same time maintain a high standing in their studies. It is never advisable, however, for a student to undertake more work of this kind than is necessary for his personal support, and if the amount is excessive, he should plan to give more than the normal five years to his college course.

The General Secretary of the Young Men's Christian Association maintains a bureau to assist students in finding employment. The positions most frequently open to young men are those as waiters at boarding places or as attendants in private houses in the care of gardens or furnaces. While the aggregate of the annual earnings of students is a large sum, the number of positions open is limited and no assurances can be given that employment will be found. Only the most faithful and self-reliant students should undertake self-support, and in no case should a student come to Evanston without sufficient means to meet expenses for at least a half-year.

Social Life of Students

In athletics, in social life and in the use of the buildings, there is no separation of the students of Engineering from the students of Liberal Arts. Engineering students go to the various buildings of the College of Liberal Arts for recitations in other than strictly engineering subjects. They share in the use of the University Library. They have free access to the new gymnasium, the largest in the United States. Their social life is mingled with that of the Liberal Arts students in one university group.

The Engineering Club, composed of students of engineering and members of the engineering faculty, provides numerous addresses by prominent engineers, and organizes inspection trips to points of engineering interest. The members of the club also furnish so many additional programs that the club holds a meeting nearly every week.

Some Advantages of the College of Engineering at Northwestern University

It offers a thorough professional course rather than a purely practical course. It places the emphasis on the fundamentals which are common to all branches of engineering. It trains its graduates for unlimited growth as engineers and for possible leadership.

The engineering courses, five years in length, are so arranged as to give each man his general broad training at the same time that he pursues his engineering studies. The Engineering students are closely associated with the larger group of Liberal Arts students, of which they, in fact, form a part.

In the purely engineering part of the course, the proportion of professors to students is much larger than is customary and each student, therefore, receives an unusual amount of attention.

There is more engineering in progress within fifty miles of the loop district of Chicago than in any area of the same size anywhere in the United States with the possible exception of New York City. The students of this College thus have an unsurpassed opportunity to keep in touch with engineering practice and to meet engineers.

The College of Engineering is a new organization not hampered by traditions, and is thus in an excellent condition to take advantage of the experience of other colleges in training engineers.

It is provided with new equipment and with a new excellent building of ample size to meet present requirements.

Inquiries for further information, requests for the catalogue of the University, for scholarship application blanks, and for blank forms of certificates from secondary schools may be addressed to the Director, College of Engineering, Northwestern University, Evanston, Ill.

1851

Northwestern University

¶ **THE COLLEGE OF LIBERAL ARTS**, located at Evanston, in an ideal college community, offers special preparation for the professions, and for pursuits requiring broad training.

¶ **THE MEDICAL SCHOOL** is one of the oldest, largest, and best equipped. Seven hospitals are open to students. Clinic material is abundant.

¶ **THE LAW SCHOOL**, the oldest law school in Chicago, offers unexcelled library facilities and special courses that prepare for immediate practice in any state upon graduation.

¶ **THE COLLEGE OF ENGINEERING** has its own building just completed, beautifully situated, a model of efficiency. Offers courses in all branches of Engineering. Technical studies in a University environment.

¶ **THE SCHOOL OF PHARMACY** offers a scientific training in Pharmacy, Chemistry, and Drug and Food Analysis. Special courses for Drug Clerks.

¶ **THE DENTAL SCHOOL** offers expert training in theory and practice. Facilities are unsurpassed. Its clinic is the largest in the world.

¶ **THE SCHOOL OF MUSIC** affords a scientific preparation for music as an accomplishment and a profession. It is located at Evanston.

¶ **THE SCHOOL OF COMMERCE** provides instruction in economics, elementary and corporation finance, commercial law and accounting. Many lecturers from business and professional life.

¶ **EVANSTON ACADEMY** prepares for college, for engineering, for professional schools, and for business.

For information regarding any school of the University address President A. W. Harris, Northwestern University Building, Chicago.

NORTHWESTERN University Bulletin is published by the University weekly during the academic year at Evanston, Illinois. Entered at the post office at Evanston, Illinois, as second class mail matter under act of Congress of July 16, 1904

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1912/13

Northwestern University

Evanston *and* Chicago

THE LIBRARY
OF THE
UNIVERSITY OF ILLINOIS

COLLEGE OF ENGINEERING ANNOUNCEMENTS

1912-1913

1851

EVANSTON, ILLINOIS

NORTHWESTERN UNIVERSITY

Special Advantages of the New College of Engineering

A thorough professional course rather than a purely practical one, with five years of broad training.

Small classes in which each student receives an unusual amount of individual attention.

A splendid new building designed for the purpose, with entirely new apparatus.

Accessibility to great engineering projects, with unsurpassed opportunities to meet engineers and keep in touch with engineering practice.

A new organization unhampered by embarrassing traditions.

Northwestern University

Evanston and Chicago

COLLEGE OF ENGINEERING ANNOUNCEMENTS

1912-1913

Evanston
Published by the University
April, 1912

SWIFT HALL OF ENGINEERING

Swift Hall of Engineering, the gift of Mrs. Gustavus F. Swift and her son, Edward F. Swift, was dedicated in 1909. The building measures fifty-eight by one-hundred and twenty.six feet; the exterior is of Bedford limestone, and presents architectural lines that are of the best; the interior is a model of appropriate decoration, convenience, safety and strength; it has concrete floors and stairways throughout. It presents five working stories, all well lighted and of good height, while the large rooms at the ends of the building are free from columns. From the beginning, it was especially planned as the home of the College of Engineering. The building is in a delightful location overlooking Lake Michigan.

Faculty

ABRAM WINEGARDNER HARRIS, Sc.D., LL.D.
President

JOHN FILLMORE HAYFORD, C.E.
Director

OLIN HANSON BASQUIN, Ph.D.
Professor of Applied Mechanics

WILLIAM CHARLES BAUER, B.S., Sc.D.
Professor of Electrical Engineering

HERBERT SHAW PHILBRICK, A.B.,B.S.
Professor of Mechanical Engineering

WILLIAM HENRY BURGER, B.S.
Assistant Professor of Civil Engineering

MILBY ROY HAMMER, B.S.
Assistant Professor of Drawing

JAMES TAFT HATFIELD, Ph.D.
Professor of German Language and Literature

HENRY CREW, Ph.D.
Professor of Physics

EDOUARD PAUL BAILLOT, L.H.D.
Professor of Romance Languages

ULYSSES SHERMAN GRANT, Ph.D.
Professor of Geology

ARTHUR CHARLES LEWIS BROWN, Ph.D.
Professor of English Literature

Willard Eugene Hotchkiss, Ph.D.
Professor of Economics

David Raymond Curtiss, Ph.D.
Professor of Mathematics

Walter Lichtenstein, Ph.D.
Librarian

Robert Richardson Tatnall, Ph.D.
Associate Professor of Physics

Murray Arnold Hines, Ph.D.
Assistant Professor of Chemistry

Clarence Stephen Marsh, A.B.
Registrar

Mabel Harriet Siller, B.L.
Assistant Registrar

Andrews Allen, C.E.
Lecturer on Contracts and Specifications

Elmer Martin Liessmann, LL.B.
Lecturer on Contracts and Specifications

George Ernest Stanford
Shop Assistant

Calendar

1912-1913

1912

Sept. 23, Mon.	Academic year 1912-1913 begins; examinations for admission; first day of registration
Sept. 25, Wed.	Second examinations
Sept. 26, Thu.	Class work begins
Nov. 28, Thu.	Thanksgiving Recess, to December 1, Sunday, inclusive
Dec. 20, Fri.	Christmas Recess, to January 6, Monday, inclusive

1913

Jan. 7, Tues.	Class work resumed
Jan. 27, Mon.	Mid-year examinations begin
Feb. 7, Fri.	Additional examinations
Feb. 7, Fri.	Second semester begins
Feb. 8, Sat.	Second examinations
Feb. 10, Mon.	Class work resumed
Feb. 22, Sat.	Washington's Birthday
Mar. 21, Fri.	Easter Recess, to March 24, Monday, inclusive
Mar. 24, Mon.	Second examinations
May 26, Mon.	Regular examinations begin
May 30, Fri.	Memorial Day
June 6, Fri.	Additional examinations
June 11, Wed.	FIFTY-FIFTH ANNUAL COMMENCEMENT
June 12, Thu.	Beginning of summer surveying
July 23, Wed.	End of summer surveying

Historical Note

THE charter of Northwestern University was signed by the Governor of Illinois on January 28, 1851. The corporation consists of forty-four trustees. An amendment to the charter provides that no intoxicating liquors shall be sold within four miles of the University.

The trustees selected as the seat of the University a tract of land on the shore of Lake Michigan, twelve miles north from the heart of Chicago. Here in 1853 the first University building was erected and about its location has grown up the City of Evanston. Here are the College of Liberal Arts, the College of Engineering, the School of Music; the schools of Medicine, Law, Pharmacy, Dentistry and Commerce are located in the City of Chicago.

The College of Liberal Arts, the oldest department of the University, was opened to students in the fall of 1855. From its small beginning it has grown, not by rapid expansion or by large benefactions, but by steady gains along conservative lines—each of its fifty-five years adding some improvements to its physical and educational equipment. Its faculty numbers forty-four professors, twenty instructors exclusive of other officers giving instruction; its students number over one thousand. The work of the College of Liberal Arts is mainly directed toward furnishing opportunities for a liberal culture or general education. The regulations affecting the choice of studies are such that the student may elect a large part of his work along lines in which he is especially interested.

In recent years a demand for instruction in engineering gradually made itself felt. A gift for the erection of an engineering building at Evanston and for its endowment led the Trustees of the University to take action in June, 1907, resulting in the establishment of a College of Engineering. This gift came from Mrs. Gustavus F. Swift and her son, Edward F. Swift. The building, known as the Swift Hall of Engineering, was dedicated in May, 1909. It is now occupied by the College of Engineering. The

Department of Mathematics of the College of Liberal Arts also has offices and recitation rooms in the building.

In the first year of its existence, 1909-1910, the College of Engineering had a total registration of fifty-nine students.

STATEMENT OF PURPOSE

The purpose of the College of Engineering of Northwestern University is to furnish to each student a thorough training for the profession of engineering, combined with a general training of the man. The College aims to train engineers for the greatest average effectiveness in a lifetime rather than for the greatest effectiveness in the first year after graduation. It aims to develop a capacity for unlimited growth. Hence strong emphasis is laid on those studies which tend to develop the man as well as on those which furnish training in engineering.

In keeping with these ideals, the courses in engineering introduce an unusual number of those non-technical studies that serve to give a general education and to develop the thinking power of the student. Unusual stress is laid upon Mathematics, upon Physics and other sciences fundamental to engineering and upon the principles which are broadly applicable to all engineering. The courses are five years in length, because past experience among colleges of engineering shows that four years is too short a time for the thorough professional training contemplated. At the end of four years the student of engineering will have secured as thorough a general training as one who comes to Northwestern University for general training alone. In recognition of that fact, he will be given the degree of Bachelor of Science by the College of Liberal Arts. During the fifth year the general training of the student is continued and he completes his professional course in engineering.

The motto of the College is "Culture for Usefulness." This motto calls for an effort to obtain for the student the broadest culture attainable in five years in order to equip him, as a man and as an engineer for the greatest possible usefulness in the world in the united struggle of man for progress.

Requirements for Admission

The requirements for admission to the College of Engineering of Northwestern University are the same as those for admission to the College of Liberal Arts.

Candidates for admission without entrance conditions must qualify by examination or by certificate on fifteen units of High School work. The unit is a course of study requiring a daily recitation on a prepared topic for a full school year, and covering in the various subjects the work defined in the University Catalogue. These definitions of units are the same as those adopted by the North Central Association of Colleges and Secondary Schools. Two hours of laboratory work are counted as the equivalent of one hour of prepared recitation.

The subjects which may be presented for admission credit and the number of units acceptable in each are shown in the following table. English, three units; Algebra, one or one and a half units; and Plane Geometry, one unit, are required of all candidates. A choice is allowed in the selection of other subjects, but at least four units of foreign languages must be presented. These may be four units of Latin, or three units of one language and one unit of another, or two units of each of two languages. A single unit of any language will be accepted only when accompanied by at least three units of some other language or two units each of two others. The remaining work may be selected at will from the subjects listed.

A candidate may be admitted to the College of Engineering as a regular student with not more than two units of condition, but entrance conditions, if any, must be made up during the first year of residence.

SUBJECTS WHICH MAY BE PRESENTED FOR ENTRANCE CREDIT

The first three subjects in the amounts indicated are required of all candidates.

English	3 units
Algebra	1 or 1½ units
Plane Geometry	1 unit

Latin	2, 3 or 4 units
Greek	2 or 3 units
German	2 or 3 units
French	2 or 3 units
Spanish	2 units
College Algebra	½ unit
Plane Trigonometry	½ unit
Solid Geometry	½ unit
Physiography	1 unit
Physics	1 unit
Botany	1 unit
Zoölogy	1 unit
Chemistry	1 unit
Ancient History	1 unit
Mediæval and Modern History	1 unit
English History	1 unit
American History (or with Civil Government)	1 unit
Civil Government	½ unit
Political Economy	½ unit
Commercial Geography	½ unit
Commercial Law	½ unit
Physiology	½ unit
Subjects not specified	2 units

Under the heading "Subjects not specified" may be presented such topics as Manual Training, Domestic Science, Mechanical Drawing, etc., at the discretion of the Board of Examiners. Subjects enumerated above as full units may be presented as half units, or may be presented in excess of the amounts stated, only under this heading and such credit will be thus limited to two units.

Each student in engineering who has not presented Solid Geometry for entrance will be required to take Solid Geometry, three hours for one semester, in the first year. As this will be an extra task, making it difficult for the student to keep up with his class, each candidate is advised to present this subject for entrance if possible.

Candidates are advised to present for entrance one and a half units of Algebra, for by so doing they may enter the course Mathematics A3, which gives a more complete training in the freshman year than does Mathematics AA, offered to those who present only one unit of Algebra.

Admission to the College of Engineering may be by certificate or by examination. Candidates for admission must be at least sixteen years of age. Graduates of accredited academies or high schools should obtain certificates of work done, showing the ground covered and the grade received in each study. These certificates should be sent to the Registrar, College of Engineering, at least one week before the opening of the fall semester. It is advisable to send them in much earlier. Certificate blanks may be had on request. Candidates who cannot present such certificates may be admitted on examination. Examinations for this purpose will be held September 23, 1912. The Board of Examiners will accept, in lieu of its examinations, those conducted by the College Entrance Examination Board. This Board holds examinations in June in the Northwestern University Building in Chicago, and at various other places in the United States.

ADVANCED STANDING

Students from other colleges seeking admission to this college must present evidence of honorable dismissal from the institution last attended and must present certificates showing (1) a full record of the applicant's preparation for college, (2) his college record, subject by subject, with the grade obtained in each subject and the year of the course in which it was taken. He should submit a catalogue of his college, bearing his name, and of the issue current at the time of his admission to that college. Students from other colleges must first meet the entrance requirements to this college after which the amount of advanced credit to be obtained by certificate will be estimated by a committee of the Faculty, but not finally placed to his credit until the student has been in residence in this college for one semester. Advanced credit without examination will be given only for work done in an approved college. Claims for advanced credit must be made during the first year of residence and not later than September of the collegiate year in which the candidate expects to graduate.

College credit for work done in a secondary school in excess of the requirements for admission can be given only on examination provided through the Registrar's office, and on the basis of five semester hours of credit for one unit of work. An exception to the examination rule is made in foreign language subjects continued in college during the first year, where the subsequent work is a sufficient test of the quality of the earlier work. Applications for such credit and for examination must be made to the Registrar during the first semester of residence and the examination must be taken at one of the regular dates set, viz.: the Wednesday of the opening week in September, the Saturday following regular examinations in February, or the Monday following Easter. Advanced credit can be allowed only in Mathematics, foreign languages, or such other subjects taken in the last year of the secondary school course as may be approved by the Committee on Advanced Standing. No examination for advanced credit will be allowed after the first year of residence nor in subjects foreign to the college curriculum.

Courses of Study

The College of Engineering offers two courses of study, each five years in length, one in Mechanical and Electrical Engineering and the other in Civil Engineering. These courses are alike in character and the same in content to the end of the third year.

For the satisfactory completion of the first four years of either course, the degree, Bachelor of Science, will be given by the College of Liberal Arts.

The degree, Electrical Engineer, will be given by the College of Engineering at the end of the five-year course in Mechanical and Electrical Engineering, and the degree, Civil Engineer, at the end of the five-year course in Civil Engineering.

COURSE IN MECHANICAL AND ELECTRICAL ENGINEERING

	Semester Hours	
Freshman Year	First Semester	Second Semester
English Language A	3	3
French A	3	3

	Semester Hours First Semester	Semester Hours Second Semester
Physics A	4	4
Mathematics A3	5	5
Mechanical Drawing, Engineering A1, or Shop Work, Engineering A2	2	..
Mechanical Drawing, Engineering A1, or Shop Work, Engineering A2	..	2
Summer Work	..	2
Sophomore Year		
German A	3	3
Physics B1	3	3
Calculus, Mathematics B1	3	3
Chemistry A	4	4
Surveying, Engineering B2	3	3
Shop Work, Engineering B1	1	1
Summer Surveying, Engineering B3	..	6
Junior Year		
Economics A	3	3
Physics C	3	3
Chemistry B1	4	..
Chemistry B2	..	4
Geology A1	4	4
Descriptive Geometry, Kinematics, and Graphical Statics, Engineering C1	3	3
Summer Work	..	2
Senior Year		
English Literature AA or AB	2	2
Structural Mechanics, Engineering D3	3	3
Calculus, Mathematics C1	3	3
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1

	Semester Hours First Semester	Semester Hours Second Semester
Electrical Engineering, Engineering D6	3	3
Elective	3	3
Summer Work	..	2
Fifth Year		
Hydraulic Engineering, Engineering E4	3	3
Thermodynamics, Engineering E1	4	..
The Public Relations of Engineers, Engineering E2	..	2
Thesis, Engineering E7	2	4
Engines, Engineering E3	3	3
Advanced Electrical Engineering, Engineering E5	3	..
Electric Power Plant Engineering, Engineering E6	..	3
Elective	2	2

COURSE IN CIVIL ENGINEERING

The first three years of this course are the same as those in the course in Mechanical and Electrical Engineering shown above.

Senior Year	Semester Hours First Semester	Semester Hours Second Semester
English Literature AA or AB	2	2
Structural Mechanics, Engineering D3	3	3
Calculus, Mathematics C1	3	3
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Electrical Machinery, Engineering D5	3	..
Heat Engines, Engineering D4	..	3
Elective Geology	3	3
Summer Work	..	2

Fifth Year	Semester Hours First Semester	Second Semester
Hydraulic Engineering, Engineering E4	3	3
Railroad Engineering, Engineering E10	4	..
The Public Relations of Engineers, Engineering E2	..	2
Thesis, Engineering E7	2	4
Structures, Engineering E9	..	5
Bridges, Engineering E8	5	..
Elective	3	3

Each course contains seventeen semester hours of credit each semester, exclusive of summer work.

For recitations or lectures one semester hour of credit is given for one period, fifty minutes, each week during one semester. For shop work, drafting or laboratory work one semester hour of credit is given for one three-hour period each week during one semester.

During each of the three summers following the first, third and fourth years the student is required to do practical work for at least six weeks, of such a character as to furnish experience of value to him as a prospective engineer. The credit assigned to six weeks of such approved work is two semester hours.

Under this requirement, students have acted as rodmen on city surveys, rodmen on the United States Lake Survey, workers in the tool room of a factory, helpers in the installation of heavy machinery in a new steam-electric power plant, foreman of a gang of laborers, helpers in the wiring of telephone switchboards,and inspectors with a company engaged in electric lighting and power distribution.

During the summer following the second year the student is required to do field work in surveying for six weeks immediately following commencement, Engineering B3, credit six semester hours. This is a regular college course under the direction of college professors, taken at a summer camp established for that purpose.

DESCRIPTIONS OF COURSES

The following paragraphs give more specific information in regard to the separate courses enumerated above as together constituting the courses in Mechanical and Electrical Enginering and in Civil Engineering:

English Language A. Rhetoric; Synonyms; Eight Essays—First semester. Drill in the elements of good style. Second semester. Rhetorical imagery and synonyms. Students who show, early in the semester, that they are seriouly deficient in elementary English, are required to take additional work for such time as may be found necessary. This course is required of all students during the first year of residence. Three semester hours throughout the year.

French A. Modern French—Baillot-Brugnot's Composition. Advanced Grammar. Reading. Madame de Girardin's La Joie fait Peur. Eugène Scribe's Les Doigts de Fée. Coppée's On rend l'Argent. Freeborn's Contes de Daudet. Pailleron's Le Monde où l'on s'Ennuie. White's Contes de Maupassant. Victor Hugo's Quatre Vingt Treize. Canfield's French Lyrics. Coppée's Le Pater. Victor Hugo's Hernani. Private reading: Cameron's Selections from Loti. Hennequin's Lessons in Idiomatic French. Essays. Three semester hours throughout the year. Open to students who present two units of French for entrance. If the student has presented no French for entrance he must take French AA, five semester hours throughout one year, in college before being admitted to French A, or if he has presented one unit of French for entrance,he must ordinarily take French AB, three semester hours throughout one year, in college before being admitted to French A.

German A. Intermediate German—Some sections take modern prose writers, Storm, Freytag, Seidel, Ernst, etc. German lyrics and ballads, Goethe's Hermann und Dorothea. Other sections take Lessing's Minna von Barnhelm, Goethe's lyrics and ballads, Schiller's Wilhelm Tell and Maria Stuart, Goethe's Hermann und Dorothea. Three semester hours throughout the year.

If the student has presented no German for entrance he must take German AA, five semester hours throughout one year, in college before being admitted to German A, or if he has presented one unit of German for entrance he must ordinarily take German AB, three semester hours throughout one year, in college before being admitted to German A.

If the student has offered for entrance two units of French and two of German he is advised to take French A in the first year and German A in the second year, but the order may be reversed. If other language units than those named in the preceding sentence have been offered for entrance, the student is required to take such language courses in the first and second years as will satisfy the language requirement for the degree of Bachelor of Science. These are not necessarily the courses French A and German A. For example, if a student has presented two or three units of Latin or of Greek for entrance he may be released, both as to entrance credits and as to college work, from a part of French or German. For complete information on this point consult the statement of prescribed courses for the degree of Bachelor of Science, in the University catalogue.

Mathematics A3. Plane Trigonometry, Algebra and Analytical Geometry—This is a course in which Plane Trigonometry, Algebra and Analytical Geometry are given together in one continuous course. Open to students who have presented one and a half units of Algebra for admission. Five semester hours throughout the year.

Mathematics AA. Algebra, Plane Trigonometry and Analytical Geometry—This is a course in which Algebra, Plane Trigonometry and Analytical Geometry are given together in one continuous course, the Algebra connecting with the first year of high school work in that subject. Open to students who have presented only one unit of Algebra for admission. Five semester hours throughout the year.

If a student has presented College Algebra or Plane Trigonometry for entrance, instead of taking Mathematics A3 in the freshman year, he is required to take three semester hours in each of two semesters in courses so arranged that with the work offered for entrance they will be equivalent to Mathematics A3.

Mathematics B1. Differential and Integral Calculus—One section of the class continues the work of Mathematics A3, including Calculus and an introduction to Solid Analytical Geometry. Another section continues the work of Mathematics A1 and A2. Three semester hours throughout the year.

Mathematics C1. Advanced Calculus—Infinite series; Taylor's theorem; partial differentiation; differential geometry; definite integrals over curves, surfaces and volumes; the Eulerian functions; Fourier's series; differential equations. Open to students who have completed Mathematics B1. Three semester hours throughout the year.

Physics A. General Physics—First semester—General properties of matter, wave-motion, sound. Second semester—Heat, electricity, magnetism, light. An introductory course requiring no mathematics beyond the requirements for entrance to college, intended to acquaint the student with the elementary facts, the method, and the general principles of physical science. Text-book: Crew's General Physics. Three lectures and one laboratory exercise each week. Open to all students. Four semester hours throughout the year.

Physics B1. Mechanics—An elementary experimental study of forces, moments of force, moments of inertia, elasticity, hydromechanics, an introduction to advanced Physics and Engineering. This is a course in pure Dynamics, and serves as an introduction to Applied Mechanics. Text-book: Crew's Principles of Mechanics. Two lectures and one laboratory exercise each week. The laboratory work is guided by especially prepared instructions. Open to students who have completed Physics A, or its equivalent, and who have completed or are taking Mathematics B1. Three semester hours throughout the year.

Physics C. Electricity and Magnetism—The more general laws of electricity and magnetism are discussed; the practical equations employed in the laboratory are derived and discussed. Text-book: J. J. Thomson's Elements of the Mathematical Theory of Electricity and Magnetism. The laboratory work includes the measurement by one or more methods of current, resistance, electromotive force, temperature-coefficients, capacity; a study of the magnetic properties of iron and steel, thermoelectric effects, the use of the electrometer, the Carey Foster bridge, potentiometer, copper voltameter, etc. Open to students who have completed or are taking Physics B1. Two lectures and one laboratory exercise each week. Three semester hours throughout the year.

Chemistry A. General Chemistry, Elementary—Text and laboratory work. Open to all students. In certain sections the course is arranged for students who have offered one unit of Chemistry for entrance and in other sections for those who have offered none. Four semester hours throughout the year.

Chemistry B1. Qualitative Analysis—Analysis of complex mixtures accompanied by lectures and quizzes on the theory of solutions, principles of equilibria, mass action, etc. Recitations and laboratory work. Open to students who have completed Chemistry A or an equivalent. Four semester hours for one semester.

Chemistry B2. Organic Chemistry—Lectures and quizzes on the hydrocarbons and their derivatives. Laboratory preparation and study of typical organic compounds. Recitations and laboratory work. Open to students who have completed Chemistry A and B1 or an equivalent. Four semester hours for one semester

Geology A1. General Geology—A general introduction to Geology. Lectures, recitations and laboratory work. Open to students who have thirty semester hours of credit and who have completed in college or in high school a year-course in Chemistry. Four semester hours throughout the year.

Geology B5. Metallurgy—Fuels, refractory and cementing materials, metallurgy of iron and steel. Open to those students of Engineering who have completed Chemistry A. Two semester hours in the first semester only.

Economics A. The Elements of Economics—An elementary course in the principles of economics. First semester. An examination of the fundamental principles of economics. Second semester. Application of these principles to practical problems. Throughout the course special attention is given to the relation between theory and practice. Open to students who have thirty hours of credit. Three semester hours throughout the year.

English Literature AA. Brief Survey of English Literature—A general outline of the development of English literature. Lectures, recitations and a considerable amount of reading. Open to students who have thirty semester hours of credit. Two semester hours throughout the year.

English Literature AB. Masterpieces of English Poetry—Minor writers are omitted or passed over briefly. The work of the course is centered on the masterpieces. Open to students who have thirty semester hours of credit. Two semester hours throughout the year.

Electives—Six semester hours of electives are provided for in the senior year of the Mechanical and Electrical Engineering course and four in the fifth year. In the fifth year of the Civil Engineering course six hours of electives are required. These electives are limited to courses given in the College of Liberal Arts, the choice to be approved by the Director.

Elective in Geology—Six hours of elective work limited to the courses in Geology given in the College of Liberal Arts, are required in the senior year of the Civil Engineering course.

Engineering A1. Mechanical Drawing—An elementary course in the technique of mechanical drawing, requiring no previous knowledge of drawing. Freehand lettering, exercise drawing, freehand sketching, shop drawing in pencil, tracing in ink on tracing cloth, machine sketching, isometric and cabinet drawing. Open to all students. Two afternoons a week. Two semester hours for one semester, to be taken in either semester.

Engineering A2. Freshman Shop Work—A series of elementary practical exercises in the shop, upon a wide variety of subjects, the object being to bring out the principles involved, to acquaint the student with a considerable range of mechanical experience and to cultivate habits both of logical thinking and of accurate work. The exercises involve some wood turning, pattern making, filing, scraping, sawing, punching, riveting, brazing, metal turning, shaping, planing, milling, grinding, etc. These exercises are guided by assigned readings, blue-printed instructions and by lectures on mechanical principles and processes, with occasional written work. Open to all students. Two afternoons a week. Two semester hours for one semester, to be taken in either semester.

Ordinarily it is expected that an engineering student will take Engineering A1 in one semester and Engineering A2 in the other semester of his freshman year.

Engineering B1. Sophomore Shop Work—This is a more intensive course than Engineering A2, limited mainly to pattern work, machine work, and tool making. The work is upon problems rather than exercises, and in them the student is given an opportunity to show his ingenuity and his grasp of the subject; while his work is directed in a general way, he is not given detailed instructions. The objects made are generally parts of some machine; this emphasizes the need for accuracy and gives a practical turn and interest to the subject. The work naturally introduces the student to a somewhat advanced knowledge of machines and processes. Open to students who have completed Engineering

A2. One afternoon each week. One semester hour throughout the year.

Engineering B2. Surveying—The use of chains, tapes, compass, level, transit, and plane table; methods of land, topographic and hydrographic surveying, including stream measurement, mine surveying and city surveying. Text-book: Theory and Practice of Surveying, by J. B. Johnson and L. S. Smith. Open to students who have completed Engineering A1 and Mathematics A3. Two recitations and one half day in the field each week. Three semester hours throughout the year.

Engineering B3. Summer Surveying—Applications under actual field conditions of the theory taught in Engineering B2. The outcome of the work will be a map of the region covered by the survey and much allied information. A new area will be covered each year, ordinarily adjacent to the area surveyed in the preceding year. The survey camp in 1911 was established in the Fox Lake region in Illinois, near Antioch. Six weeks immediately following commencement. Open to students who have completed Engineering B2. Credit six semester hours.

Engineering C1. Descriptive Geometry, Kinematics and Graphical Statics—The course is divided into three equal parts. (1) Descriptive Geometry; first principles; point, line and plane; curved lines and surfaces; plane sections and developments; intersections of surfaces. Text-book: Essentials of Descriptive Geometry by Phillips and Millar. (2) Kinematics; elementary propositions; communication of motion by rolling and sliding contact, by link work, by wrapping connectors; trains of mechanism; aggregate combinations. Text-book: Elementary Mechanism by Stahl and Woods. (3) Graphical Statics: general principles; concurrent and non-concurrent forces; moments; center of gravity of areas; moment of inertia; roof trusses; loads; reactions; stresses; wind load stresses; cantilever and unsymmetrical trusses; counterbracing; three-hinged arch; transverse bent. Text: Graphic Statics, by Malcolm. Open to students who have completed

Engineering A1 and Mathematics A3. One recitation period and two half days of drawing each week. Three semester hours throughout the year.

Engineering D1. Contracts and Specifications—The course deals with contracts and specifications as applied to engineering only. Recitations and lectures. Text-book: Engineering Law by Alexander Haring. Open to students who have sixty hours of credit. Two semester hours in the second semester only.

Engineering D2. Journal Meeting—The time is spent in reading and reviewing current engineering literature, the object being to acquaint the student with this fund of information, to show him the necessity of judicious selection from the great mass of such current literature, to indicate methods of selection, and to cultivate a habit of accurate reading. Open to students who have taken or who are taking Engineering D3, D4, D5 or D6. One afternoon each week. One semester hour throughout the year.

Engineering D3. Structural Mechanics—The text-book work is upon the application of mechanics to the elementary parts of structures, taking up properties of materials, testing materials, elementary theory of elasticity, stresses and strains of beams, columns, shafts, tubes, curved bars, springs and bodies in rapid rotation; stability of piles and retaining walls; elementary theory of reinforced concrete. The laboratory work relates partly to standard methods of testing materials such as steel and cement, but it is largely involved in an effort to bring to the clear comprehension of the student the various relations deduced in the text-book work upon the subject. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering D4. Heat Engines—A course in prime movers and general power plant equipment. Elementary thermodynamics. Construction and operation of steam engines, turbines and gas engines. Engine testing. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours in the second semester only.

Engineering D5. Electrical Machinery—A course in Direct and Alternating Current Machines. Special emphasis is placed upon the study of the fundamental principles involved and upon the application of these principles in practice. Electrical testing. Open to students who have completed Mathematics B1 and Physics C. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering D6. Electrical Engineering—First semester—A general study of the fundamental principles of Electrical Engineering and their applications to direct current machinery. A selected series of problems are assigned to illustrate quantitatively the principles involved. Second semester—A general study of the fundamental principles of single and polyphase alternating currents, with special reference to analytic, graphic and symbolic methods of treatment. Elementary analysis of alternating current machinery. Open to students who have completed Physics C and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E1. Thermodynamics—The course consists of text-book work first upon the general theory of thermodynamics, and later upon its application to heat engines, taking up properties of gases, flow of gases, thermodynamics of air engines, internal combustion engines and air compressors, properties of steam and other vapors, thermodynamics of steam engines and steam turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Four semester hours in the first semester only.

Engineering E2. The Public Relations of Engineers—A course of lectures and reading dealing with the relations of a practicing engineer to other men. It will deal in part with biographies of engineers, the history of engineering, the purpose of organization and the conservation of natural resources. Open to students who have taken or who are taking Engineering E1, E3, E4, E5 or E6. Two semester hours in the second semester only.

Engineering E3. Engines—A detailed study of the steam engine, steam turbine, boiler plant equipment, gas engines and producer gas plants. Open to students who have taken or who are taking Engineering E1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E4. Hydraulic Engineering—The theory and application of the principles of hydrostatics and hydrodynamics; measurements of flow by pressure gages, meters, Pitot tubes and weirs; path, energy and impulse of jets; flow through orifices, tubes and pipes with loss of energy or head due to contractions, expansions and nozzles; derivation and application of formulæ for discharge, velocity and pressure; work derived from moving vanes as in water wheels and turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E5. Advanced Electrical Engineering—Advanced analysis by the analytic, symbolic and graphic methods of treatment of alternating current machinery, of general alternating current and of transient phenomena. Lectures, assigned reading, recitations and laboratory work. Open to students who have completed Engineering D6. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering E6. Electric Power Plant Engineering—A study of special problems in connection with the generation and transmission of electrical energy in large systems and in high potential systems. Emphasis is laid upon the proper relation of parts to form a complete plant. Lectures, assigned reading, recitations and laboratory work. Open to students who have completed

Engineering E5. Two recitations and one laboratory period each week. Three semester hours in the second semester only.

Engineering E7. Thesis—Open to students in the last year in the Engineering course. Two semester hours in the first and four in the second semester.

Engineering E8. Bridges—A general course on the theory and design of bridges, taking up stone arches, reinforced concrete arches, culverts and steel bridges of many types. Open to students who have completed Engineering D3. Three recitations and two half days of drawing each week. Five semester hours in the second semester only.

Engineering E9. Structures—A general course on the theory and design of foundations, retaining walls, tall chimneys, masonry dams and building construction. Open to students who have completed Engineering D3. Three recitations and two half days of drawing each week. Five semester hours in the first semester only.

Engineering E10. Railroad Engineering—The use of the transit, chain, level, etc., in laying out simple, compound and vertical curves; methods of reconnaissance, preliminary and location surveys; turnouts, switches and wye tracks; profile and cross section surveys, and computation of earthwork; haul and mass diagrams; maps and drawings; the use of topographic surveys in location; drainage, waterways and bridge staking. Economic theory of railway location, construction, extension and maintenance. Field work consists of laying out a short line and of the practical application of methods of staking, computation and mapping given above. Open to students who have completed Engineering B2 and Mathematics B1. Three recitations and one half day in the field each week. Four semester hours in the first semester only.

General Regulations

REGISTRATION

Every student is required to register in person at the office of the Registrar, College of Engineering, before entering upon college work. Registration days are the first Monday, Tuesday, Wednesday and Thursday of each semester. Returning students who register after the close of this period are subject to a fee of two dollars.

On the registration days of the first semester the student must register for the work of the whole year. Changes may be made only with the consent of the Director. A course dropped without consent is regarded as a failure and is so recorded.

At the time of registration the student obtains from the Registrar his tuition bill for the semester. This must be presented immediately at the Business Manager's Office for payment.

CLASSIFICATION

Students in the College of Engineering are grouped in five classes according to their credits in the office of the Registrar. The basis for their classification is as follows:

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first four years, and who have satisfied all entrance requirements, are classed as fifth year students.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first three years, and who have satisfied all entrance requirements, are classed as seniors.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first two years, and who have satisfied all entrance requirements, are classed as juniors.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first year, and who have satisfied all entrance requirements, are classed as sophomores.

All other regular students are classed as freshmen, without regard to the date of admission.

GRADES OF SCHOLARSHIP, EXAMINATIONS, AND ATTENDANCE

In other matters of student regulation, such as examinations, grades of scholarship, class and chapel attendance, and physical training, the students of the College of Engineering are governed by the regulations stated in the general University Catalogue and in the Undergraduate's Manual.

FEES AND EXPENSES

Matriculation Fee, paid on first registration	$5.00
Tuition Fee, a year	100.00

Payable one-half at the beginning of the first semester, one-half at the beginning of the second.

Laboratory Fees

Chemistry A	$7.50 a semester
Chemistry B or B2	9.00 a semester
Geology A1	2.00 a semester
Physics A or B1	2.00 a semester
Physics C	3.00 a semester
Engineering A1	6.00 a semester
Engineering A2	8.00 a semester
Engineering B1	4.00 a semester
Engineering B2 or D3	5.00 a semester
Engineering C1, D4, D5, D6, E4, E5 or E6	3.00 a semester
Fee for summer surveying course, Engineering B3	15.00
Diploma Fee	10.00

The laboratory fees for engineering courses are intended to cover ordinary depreciation of apparatus and the use of materials. The student is held responsible for any damage due to his negligence.

Laboratory fees are not refunded if the student continues in a course as long as two weeks, except that in the Chemical Laboratory the fee is in the nature of a deposit, where an account is kept of the material used and the unexpended balances, at the end of the year, are returned to the student.

The tuition fees will not be refunded except in case of sickness. If a student withdraws before the middle of the semester, on account of serious illness, one-half of his tuition fee will be refunded, on his obtaining from the Director a statement of honorable standing, and from a physician a certificate that his health will not permit him to remain in attendance.

Reduced rates of tuition are given to sons of clergymen who are actively pursuing the work of the ministry ($30.00 per semester) and to holders of old-time perpetual or transferable scholarships for incidentals ($22.00 per semester).

The remaining necessary expenses of a student, namely, board, room, laundry, text-books and stationery, for nine months, vary from $200 to $370, the average being about $270.

Students find confortable homes in private families or live in clubhouses under their own management. Clubs are formed in which the cost of table board is reduced to a minimum.

SCHOLARSHIPS

A few scholarships, which cover tuition, are awarded annually (three in 1911-1912) to select members of the incoming class, upon applications endorsed by the principal and faculty of the secondary school from which the applicant graduates. The applicant must meet the full entrance requirements and must present certificates from the teachers in his secondary school for excellence of character and scholarship, for physical vigor, manliness and promise of usefulness as a citizen. The award is made at the University by a committee of the College faculty.

A few scholarships, which cover tuition, are awarded annually (two in 1911-1912) to select members of the upper classes.

The upper class scholarship known as the *Swift Scholarship* was offered by Mrs. Gustavus F. Swift to members of the upper classes for the years 1911-1912 and 1912-1913.

OPPORTUNITIES FOR SELF-HELP

Some students in Evanston have been able, while in college, to earn the cost of their living in full, and every year a large percentage earn a considerable portion of their expenses, and at the same time maintain a high standing in their studies. It is never advisable, however, for a student to undertake more work of this kind than is necessary for his personal support, and if the amount is excessive, he should plan to give more than the normal five years to his college course.

The General Secretary of the Young Men's Christian Association maintains a bureau to assist students in finding employment. The positions most frequently open to young men are those as waiters at boarding places or as attendants in private houses in the care of gardens or furnaces. While the aggregate of the annual earnings of students is a large sum, the number of positions open is limited and no assurances can be given that employment will be found. Only the most faithful and self-reliant students should undertake self-support, and in no case should a student come to Evanston without sufficient means to meet expenses for at least a half-year.

RELIGIOUS AND SOCIAL LIFE OF STUDENTS

The charter of the University provides that "no particular religious faith shall be required of those who become students of this institution." Students are expected to attend public worship on Sunday in the church of their choice. Chapel service is held at ten o'clock on each week day, except Saturday, throughout the college year. Attendance upon at least three-fifths of these services is required. Under the direction of the Young Men's Christian Association religious meetings are held each week.

In athletics, in social life and in the use of the buildings, there is no separation of the students of Engineering from the students of Liberal Arts. Engineering students go to the various buildings of the College of Liberal Arts for recitations in other than strictly engineering subjects. They share in the use of the University Library. They have free access to the new gymnasium, the largest in the United States. Their social life is mingled with that of the Liberal Arts students in one university group.

The Engineering Society, composed of students of engineering and members of the engineering faculty, provides numerous addresses by prominent engineers, and organizes inspection trips to points of engineering interest. The members also furnish many additional programs so that the society holds a meeting nearly every week.

Some Advantages of the College of Engineering at Northwestern University

It offers a thorough professional course rather than a purely practical course. It places the emphasis on the fundamentals which are common to all branches of engineering. It trains its graduates for unlimited growth as engineers and for possible leadership.

The engineering courses, five years in length, are so arranged as to give each man his general broad training at the same time that he pursues his engineering studies. The engineering students are closely associated with the larger group of Liberal Arts students, of which they, in fact, form a part.

In the purely engineering part of the course, the proportion of professors to students is much larger than is customary and each student, therefore, receives an unusual amount of attention.

There is more engineering in progress within fifty miles of the loop district of Chicago than in any area of the same size anywhere in the United States with the possible exception of New York City. The students of this College thus have an unsurpassed opportunity to keep in touch with engineering practice and to meet engineers.

The College of Engineering is a new organization not hampered by traditions, and is thus in an excellent condition to take advantage of the experience of other colleges in training engineers.

It is provided with new equipment and with a new excellent building of ample size to meet present requirements.

Inquiries for further information, requests for the catalogue of the University, for scholarship application blanks, and for blank forms of certificates from secondary schools may be addressed to John F. Hayford, Director, College of Engineering, Northwestern University, Evanston, Illinois.

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1851

Northwestern University

¶ THE COLLEGE OF LIBERAL ARTS, located at Evanston, in an ideal college community, offers special preparation for the professions, and for pursuits requiring broad training.

¶ THE MEDICAL SCHOOL is one of the oldest, largest, and best equipped. Seven hospitals are open to students. Clinic material is abundant.

¶ THE LAW SCHOOL, the oldest law school in Chicago, offers unexcelled library facilities and special courses that prepare for immediate practice in any state upon graduation.

¶ THE COLLEGE OF ENGINEERING has its own building just completed, beautifully situated, a model of efficiency. Offers courses in all branches of Engineering. Technical studies in a University environment.

¶ THE SCHOOL OF PHARMACY offers a scientific training in Pharmacy, Chemistry and Drug and Food Analysis. Special courses for Drug Clerks.

¶ THE DENTAL SCHOOL offers expert training in theory and practice. Facilities are unsurpassed. Its clinic is the largest in the world.

¶ THE SCHOOL OF MUSIC affords a scientific preparation for music as an accomplishment and a profession. It is located at Evanston.

¶ THE SCHOOL OF COMMERCE provides instruction in economics, elementary and corporation finance, commercial law and accounting. Many lecturers from business and professional life.

¶ EVANSTON ACADEMY prepares for college, for engineering, for professional schools and for business.

For information regarding any school of the University, address President A. W. Harris, Northwestern University Building, Chicago.

NORTHWESTERN UNIVERSITY BULLETIN is published by the University weekly during the academic year at Evanston, Illinois. Entered at the post-office at Evanston, Illinois, as second class mail matter under act of Congress of July 16, 1904.

Volume XII, Number 35, April 26, 1912

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Northwestern University Bulletin

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COLLEGE *of* ENGINEERING ANNOUNCEMENTS

1913-1914

UNIVERSITY OF ILLINOIS
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EVANSTON, ILLINOIS

NORTHWESTERN UNIVERSITY

Special Advantages of the New College of Engineering

A thorough professional course rather than a purely practical one, with five years of broad training.

Small classes in which each student receives an unusual amount of individual attention.

A splendid new building designed for the purpose, with entirely new apparatus.

Accessibility to great engineering projects, with unsurpassed opportunities to meet engineers and keep in touch with engineering practice.

A new organization unhampered by embarrassing traditions.

Northwestern University Bulletin

COLLEGE *of* ENGINEERING ANNOUNCEMENTS
1913-1914

Evanston
Published by the University
March, 1913

SWIFT HALL OF ENGINEERING

Swift Hall of Engineering, the gift of Mrs. Gustavus F. Swift and her son, Edward F. Swift, was dedicated in 1909. The building measures fifty-eight by one-hundred and twenty.six feet; the exterior is of Bedford limestone, and presents architectural lines that are of the best; the interior is a model of appropriate decoration, convenience, safety and strength; it has concrete floors and stairways throughout. It presents five working stories, all well lighted and of good height, while the large rooms at the ends of the building are free from columns. From the beginning, it was especially planned as the home of the College of Engineering. The building is in a delightful location overlooking Lake Michigan.

Faculty

Abram Winegardner Harris, Sc.D., LL.D.
President

John Fillmore Hayford, C.E.
Director

Olin Hanson Basquin, Ph.D.
Professor of Applied Mechanics

William Charles Bauer, B.S., Sc.D.
Professor of Electrical Engineering

Herbert Shaw Philbrick, B.A.,B.S.
Professor of Mechanical Engineering

William Henry Burger, B.S.
Assistant Professor of Civil Engineering

Milby Roy Hammer, B.S.
Assistant Professor of Drawing

James Taft Hatfield, Ph.D.
Professor of German Language and Literature

Henry Crew, Ph.D.
Professor of Physics

Edouard Paul Baillot, L.H.D.
Professor of Romance Languages

Ulysses Sherman Grant, Ph.D.
Professor of Geology

Arthur Charles Lewis Brown, Ph.D.
Professor of English Literature

WILLARD EUGENE HOTCHKISS, Ph.D.
Professor of Economics

DAVID RAYMOND CURTISS, Ph.D.
Professor of Mathematics

WALTER LICHTENSTEIN, Ph.D.
Librarian

ROBERT RICHARDSON TATNALL, Ph.D.
Associate Professor of Physics

MURRAY ARNOLD HINES, Ph.D.
Assistant Professor of Chemistry

CLARENCE STEPHEN MARSH, B.A.
Registrar

MABEL HARRIET SILLER, B.L.
Assistant Registrar

ANDREWS ALLEN, C.E.
Lecturer on Contracts and Specifications

ELMER MARTIN LIESSMANN, LL.B.
Lecturer on Contracts and Specifications

GEORGE ERNEST STANFORD
Shop Assistant

Calendar

1913-1914

1913

Sept. 22, Mon.	Academic year 1913-1914 begins; examinations for admission; first day of registration
Sept. 24, Wed.	Second examinations
Sept. 25, Thu.	Class work begins
Nov. 27, Thu.	Thanksgiving Recess, to November 30, Sunday, inclusive
Dec. 20, Sat.	Christmas Recess, to January 5, Monday, inclusive

1914

Jan. 6, Tues.	Class work resumed
Jan. 26, Mon.	Mid-year examinations begin
Feb. 6, Fri.	Additional examinations
Feb. 6, Fri.	and February 7, Saturday, Registration Day
Feb. 7, Sat.	Second examinations
Feb. 9, Mon.	Class work resumed
Apr. 10, Fri.	Easter Recess, to April 13, Monday, inclusive
Apr. 13, Mon.	Second examinations
May 25, Mon.	Regular examinations begin
May 30, Sat.	Memorial Day
June 5, Fri.	Additional examinations
June 10, Wed.	FIFTY-SIXTH ANNUAL COMMENCEMENT
June 11, Thu.	Beginning of summer surveying
July 22, Wed.	End of summer surveying

Historical Note

THE charter of Northwestern University was signed by the Governor of Illinois on January 28, 1851. The corporation consists of forty-four trustees. An amendment to the charter provides that no intoxicating liquors shall be sold within four miles of the University.

The trustees selected as the seat of the University a tract of land on the shore of Lake Michigan, twelve miles north from the heart of Chicago. Here in 1853 the first University building was erected and about its location has grown up the City of Evanston. Here are the College of Liberal Arts, the College of Engineering, the School of Music. The schools of Medicine, Law, Pharmacy, Dentistry and Commerce are located in the City of Chicago.

The College of Liberal Arts, the oldest department of the University, was opened to students in the fall of 1855. From its small beginning it has grown, not by rapid expansion or by large benefactions, but by steady gains along conservative lines—each of its fifty-five years adding some improvements to its physical and educational equipment. The work of the College of Liberal Arts is mainly directed toward furnishing opportunities for a liberal culture or general education. The regulations affecting the choice of studies are such that the student may elect a large part of his work along lines in which he is especially interested.

In recent years a demand for instruction in engineering gradually made itself felt. A gift for the erection of an engineering building at Evanston and for its endowment led the Trustees of the University to take action in June, 1907, resulting in the establishment of a College of Engineering. This gift came from Mrs. Gustavus F. Swift and her son, Edward F. Swift. The building, known as the Swift Hall of Engineering, was dedicated in May, 1909. It is now occupied by the College of Engineering. The

Department of Mathematics of the College of Liberal Arts also has offices and recitation rooms in the building.

In 1912-1913, the College of Engineering had a total registration of fifty-eight students.

STATEMENT OF PURPOSE

The purpose of the College of Engineering of Northwestern University is to furnish to each student a thorough training for the profession of engineering, combined with a general training of the man. The College aims to train engineers for the greatest average effectiveness in a lifetime rather than for the greatest effectiveness in the first year after graduation. It aims to develop a capacity for unlimited growth. Hence strong emphasis is laid on those studies which tend to develop the man as well as on those which furnish training in engineering.

In keeping with these ideals, the courses in engineering introduce an unusual number of those non-technical studies that serve to give a general education and to develop the thinking power of the student. Unusual stress is laid upon Mathematics, upon Physics and other sciences fundamental to engineering and upon the principles which are broadly applicable to all engineering. The courses are five years in length, because past experience among colleges of engineering shows that four years is too short a time for the thorough professional training contemplated. At the end of four years the student of engineering will have secured as thorough a general training as one who comes to Northwestern University for general training alone. In recognition of that fact, he will be given the degree of Bachelor of Science by the College of Liberal Arts. During the fifth year the general training of the student is continued and he completes his professional course in engineering.

The motto of the College is "Culture for Usefulness." This motto calls for an effort to obtain for the student the broadest culture attainable in five years in order to equip him, as a man and as an engineer for the greatest possible usefulness in the world in the united struggle of man for progress.

Change in Admission Requirements

The requirements for admission are stated below as amended to take effect in September 1913. The amendment consists primarily of allowing the candidate the option of offering either four units of foreign language or two units of foreign language plus two units from a restricted list of subjects deemed to be of especial value as preparation for success in following the curriculum of the College of Engineering. The fixed requirement in Algebra has also been increased from one to one and one-half units, so as to include Algebra (b).

Requirements for Admission

Candidates for admission without entrance conditions must qualify by examination or by certificate on fifteen units of High School work. The unit is a course of study requiring a daily recitation on a prepared topic for a full school year, and covering in the various subjects the work defined in the University Catalogue.

The subjects which may be presented for admission credit and the number of units acceptable in each are shown in the following table:

English, three units; Algebra, one and a half units; and Plane Geometry, one unit, are required of all candidates. A choice is allowed in the selection of other subjects, but the choice must include either four units of foreign language or two units of foreign language plus two units chosen from the following group: College Algebra one-half unit, Plane Trigonometry one-half unit, Solid Geometry one-half unit, Physics one unit, Chemistry one unit, Manual Training one or two units, and Mechanical Drawing one or two units. The choice of foreign language is limited to Latin, Greek, French, German and Spanish and to a certain maximum number of units in each as indicated in the table which follows. A single unit of any language will be accepted only when accompanied by at least three units of some other language or two units each of two others. The remaining five and one-half units required to make an aggregate of fifteen units may be selected at will from the subjects listed in the following table.

Latin	2, 3 or 4 units	English History	1 unit
Greek	2 or 3 units	American History (or with Civil Government)	1 unit
German	2 or 3 units	Civil Government	½ unit
French	2 or 3 units	Political Economy	½ unit
Spanish	2 units	Commercial Geography	½ unit
College Algebra	½ unit	Commercial Law	½ unit
Plane Trigonometry	½ unit	Physiology	½ unit
Solid Geometry	½ unit	Mechanical Drawing	1 or 2 units
Physiography	1 unit	Manual Training	1 or 2 units
Physics	1 unit	Subjects not specified	2 units
Botany	1 unit		
Zoölogy	1 unit		
Chemistry	1 unit		
Ancient History	1 unit		
Mediæval and Modern History	1 unit		

Under the heading "Subjects not specified" other topics may be presented, at the discretion of the Board of Examiners. Subjects enumerated above as full units may be presented as half units, or may be presented in excess of the amounts stated, only under this heading and such credit will be thus limited to two units.

One unit of entrance credit in Mechanical Drawing may be given for twelve hours work per week for a full school year, or an equivalent amount of time, provided the work is of an acceptable character. A second unit of credit may be given in Mechanical Drawing only in case the course in drawing taken in school covers the full equivalent of the course Engineering A1 of the College of Engineering.

One unit of entrance credit in Manual Training may be given for twelve hours work per week for a full school year, or an equivalent amount of time, provided the work is of an acceptable character. A second unit of credit may be given in Manual Training only in case the course in Manual Training taken in school covers the full equivalent of the course Engineering A2 of the College of Engineering.

For a statement in detail of the definitions of other entrance units consult the Catalogue of the University.

Each student in engineering who has not presented Solid Geometry for entrance will be required to take Solid Geometry, three hours for one semester, in the first year. As this will be an extra task, making it difficult for the student to keep up with his class, each candidate is advised to present this subject for entrance if possible.

So, too, there are various other ways in which a student in meeting the entrance requirements may by his selection of the subjects presented either lighten his later college work, or may so handicap himself as to make it difficult to secure an engineering degree in five years. For a general suggestion on this point, consult page 13.

A candidate may be admitted to the College of Engineering as a regular student with not more than two units of condition, but entrance conditions, if any, must be made up during the first year of residence.

Admission to the College of Engineering may be by certificate or by examination. Candidates for admission must be at least sixteen years of age. Graduates of accredited academies or high schools should obtain certificates of work done, showing the ground covered and the grade received in each study. These certificates should be sent to the Registrar, College of Engineering, at least one week before the opening of the fall semester. It is advisable to send them in much earlier. Certificate blanks may be had on request. Candidates who cannot present such certificates may be admitted on examination. Examinations for this purpose will be held September 22, 1913. The Board of Examiners will accept, in lieu of its examinations, those conducted by the College Entrance Examination Board. This Board holds examinations in June in the Northwestern University Building in Chicago, and at various other places in the United States.

ADVANCED STANDING

Students from other colleges seeking admission to this college must present evidence of honorable dismissal from the institution last attended and must present certificates showing (1) a full record of the applicant's preparation for college, (2) his college record, subject by subject, with the grade obtained in each subject and the year of the course in which it was taken. He should submit a catalogue of his college, bearing his name, and of the issue current at the time of his admission to that college. Students from other colleges must first meet the entrance requirements to this college after which the amount of advanced credit to be obtained by certificate will be estimated by a committee of the Faculty, but not finally placed to his credit until the student has been in residence in this college for one semester. Advanced credit without examination will be given only for work done in an approved college. Claims for advanced credit must be made during the first year of residence and not later than September of the collegiate year in which the candidate expects to graduate.

College credit for work done in a secondary school in excess of the requirements for admission can be given only on examination provided through the Registrar's office, and on the basis of five semester hours of credit for one unit of work. An exception to the examination rule is made in foreign language subjects continued in college during the first year, where the subsequent work is a sufficient test of the quality of the earlier work. Applications for such credit and for examination must be made to the Registrar during the first semester of residence and the examination must be taken at one of the regular dates set, viz.: the Wednesday of the opening week in September, the Saturday following regular examinations in February, or the Monday following Easter. Advanced credit can be allowed only in Mathematics, foreign languages, or such other subjects taken in the last year of the secondary school course as may be approved by the Committee on Advanced Standing. No examination for advanced credit will be allowed after the first year of residence nor in subjects foreign to the college curriculum.

Courses of Study

The College of Engineering offers two courses of study, each five years in length, one in Mechanical and Electrical Engineering and the other in Civil Engineering. These courses are alike in character and the same in content to the end of the third year.

For the satisfactory completion of the first four years of either course, the degree, Bachelor of Science, will be given by the College of Liberal Arts.

The degree, Electrical Engineer, will be given by the College of Engineering at the end of the five-year course in Mechanical and Electrical Engineering, and the degree, Civil Engineer, at the end of the five-year course in Civil Engineering.

COURSE IN MECHANICAL AND ELECTRICAL ENGINEERING

	Semester Hours First Semester	Semester Hours Second Semester
Freshman Year		
English A1	3	..
English A3	..	3
French A	3	3
Physics A	4	4
Mathematics A3	5	5
Mechanical Drawing, Engineering A1, or Shop Work, Engineering A2	2	..
Mechanical Drawing, Engineering A1, or Shop Work, Engineering A2	..	2
Summer Work	..	2
Sophomore Year		
German A	3	3
Physics B1	3	3
Calculus, Mathematics B1	3	3
Chemistry A	4	4
Surveying, Engineering B2	3	3

	Semester Hours First Semester	Semester Hours Second Semester
Shop Work, Engineering B1	1	1
Summer Surveying, Engineering B3	..	6
Junior Year		
Economics A	3	3
Physics C1	3	3
Chemistry B1	4	..
Chemistry B2	..	4
Geology A1	4	4
Descriptive Geometry, Kinematics, and Graphical Statics, Engineering C1	3	3
Summer Work	..	2
Senior Year		
English B1 or B2	2	2
Structural Mechanics, Engineering D3	3	3
Calculus, Mathematics C1	3	3
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Electrical Engineering, Engineering D6	3	3
Elective	3	3
Summer Work	..	2
Fifth Year		
Hydraulic Engineering, Engineering E4	3	3
Thermodynamics, Engineering E1	4	..
The Public Relations of Engineers, Engineering E2	..	2
Thesis, Engineering E7	2	4
Engines, Engineering E3	3	3
Advanced Electrical Engineering, Engineering E5	3	..
Electric Power Plant Engineering, Engineering E6	..	3
Elective	2	2

COURSE IN CIVIL ENGINEERING

The first three years of this course are the same as those in the course in Mechanical and Electrical Engineering shown above.

	Semester Hours	
Senior Year	First Semester	Second Semester
English B1 or B2	2	2
Structural Mechanics, Engineering D3	3	3
Calculus, Mathematics C1	3	3
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Electrical Machinery, Engineering D5	3	..
Heat Engines, Engineering D4	..	3
Elective in Geology	3	3
Summer Work	..	2
Fifth Year		
Hydraulic Engineering, Engineering E4	3	3
Railroad Engineering, Engineering E10	4	..
The Public Relations of Engineers, Engineering E2	..	2
Thesis, Engineering E7	2	4
Structures, Engineering E9	5	..
Bridges, Engineering E8	..	5
Elective	3	3

Each course contains seventeen semester hours of credit each semester, exclusive of summer work.

Each course may be taken precisely as shown above by a student who enters the College with the standard preparation which includes English three units, Algebra one and one-half units, Plane Geometry one unit, Solid Geometry one-half unit, French two units, and German two units. If however the student enters College deficient in any of the subjects enumerated in the preceding sentence and the deficiency is not counterbalanced by excess elsewhere in his preparation of the character indicated later in this paragraph, it will be impossible for him to complete either engineering course in five years without securing more than an average of seventeen semester hours of credit in each semester. Only an exceptionally strong student may expect to secure more than seventeen hours of credit per semester. Certain subjects when accepted for entrance credit constitute an excess in the sense that they relieve the student offering them of some college work which would otherwise be required of him in the engineering courses. These are College Algebra, Plane Trigonometry, Chemistry (if accepted by the department of Chemistry as warranting the student's admission directly to the college course Chemistry AB instead of to Chemistry A), a second unit of Mechanical Drawing, a second unit of Manual Training, and such preparation in foreign language as will leave the student less than twelve semester hours of foreign language to be taken in college in order to meet the requirements for the degree of Bachelor of Science which are shown in the Catalogue of the University. As an example it may be stated that a student who presents three units of German or Latin, and two of French, is required to take in college French A only, six semester hours, instead of both French A and German A as listed above, twelve semester hours.

For recitations or lectures one semester hour of credit is given for one period, fifty minutes, each week during one semester. For shop work, drafting or laboratory work, one semester hour of credit is given for one three-hour period each week during one semester.

During each of the three summers following the first, third and fourth years the student is required to do practical work for at least six weeks, of such a character as to furnish experience of value to him as a prospective engineer. The credit assigned to six weeks of such approved work is two semester hours.

Under this requirement, students have acted as rodmen on city surveys, rodmen on the United States Lake Survey, workers in the tool room of a factory, helpers in the installation of heavy machinery in a new steam-electric power plant, foreman of a gang of laborers, helpers in the wiring of telephone switchboards, and inspectors with a company engaged in electric lighting and power distribution.

During the summer following the second year the student is required to do field work in surveying for six weeks immediately following commencement, Engineering B3, credit six semester hours. This is a regular college course under the direction of college professors, taken at a summer camp established for that purpose.

DESCRIPTIONS OF COURSES

The following paragraphs give more specific information in regard to the separate courses enumerated above as together constituting the courses in Mechanical and Electrical Engineering and in Civil Engineering:

English A1. Composition and Rhetoric. Required of all students in their first year, except those who take English A2. Three semester hours in the first semester only.

English A2. Composition and Rhetoric. Required of students whose preparation is found to be insufficient for English A1. No credit is given for the first semester until the work of the second semester has been completed. Three semester hours in the first semester and two in the second semester.

English A3. Outline of English Literature. Required of all students in their first year. Three semester hours in the second semester only.

French A. Modern French. Koren's Composition. Buffum's French Short Stories. Advanced Grammar. Reading. Coppee's On rend l'Argent. Pailleron's Le Monde ou l'on s'Ennuie. Victor Hugo's Quatre-Vingt Trieze. Canfield's French Lyrics. Coppee's Le Pater. Victor Hugo's Hernani. Private reading: Cameron's Selections from Loti. Three semester hours throughout the year. Open to students who present two units of French for entrance. If the student has presented no French for entrance he must take French AA, five semester hours throughout one year, in college before being admitted to French A, or if he has presented one unit of French for entrance, he must ordinarily take French AB, three semester hours throughout one year, in college before being admitted to French A.

German A. Intermediate German—Some sections take modern prose writers, Storm, Freytag, Seidel, Hoffmann, Ernst, etc. German lyrics and ballads. Other sections take Lessing's Minna von Barnhelm, German lyrics and ballads, Schiller's Wilhelm Tell and Maria Stuart, Lessing's Nathan der Weisse. Three semester hours throughout the year. Open to students who present two units of German for entrance. If the student has presented no German for entrance he must take German AA, five semester hours throughout one year, in college before being admitted to German A, or if he has presented one unit of German for entrance he must ordinarily take German AB, three semester hours throughout one year, in college before being admitted to German A.

If the student has offered for entrance two units of French and two of German, he is advised to take French A in the first year and German A in the second year, but the order may be reversed. If other language units than those named in the preceding sentence have been offered for entrance, the student is required to take such language courses as will satisfy the language requirement for the degree of Bachelor of Science. These are not necessarily the courses French A and German A. For example, if a student has presented two or three units of Latin or of Greek for entrance he may be released, both as to entrance credits and as to college work, from a part of French or German. For complete information on this point, consult the statement of prescribed courses for the degree of Bachelor of Science, in the University catalogue.

Mathematics A3. Plane Trigonometry, Algebra and Analytical Geometry—This is a course in which Plane Trigonometry, Algebra and Analytical Geometry are given together in one continuous course. Open to students who have presented one and a half units of Algebra for admission. Five semester hours throughout the year.

If a student has presented College Algebra or Plane Trigonometry for entrance, instead of taking Mathematics A3 in the freshman year, he is required to take three semester hours in each of two semesters in courses so arranged that with the work offered for entrance they will be equivalent to Mathematics A3.

Mathematics B1. Differential and Integral Calculus. A first course in Calculus, including its simpler applications. Open to students who have completed Mathematics A3, or an equivalent. Three semester hours throughout the year.

Mathematics C1. Advanced Calculus—Infinite series; Taylor's theorem; partial differentiation; differential geometry; definite integrals over curves, surfaces and volumes; the Eulerian functions; Fourier's series; differential equations. Open to students who have completed Mathematics B1. Three semester hours throughout the year.

Physics A. General Physics—First semester—General properties of matter, wave-motion, sound. Second semester—Heat, electricity, magnetism, light. An introductory course requiring no mathematics beyond the requirements for entrance to college, intended to acquaint the student with the elementary facts, the method, and the general principles of physical science. Text-book: Crew's General Physics. Three lectures and one laboratory exercise each week. Open to all students. Four semester hours throughout the year.

Physics B1. Mechanics—An elementary experimental study of forces, moments of force, moments of inertia, elasticity, hydromechanics, an introduction to advanced Physics and Engineering. This is a course in pure Dynamics, and serves as an introduction to Applied Mechanics. Text-book: Crew's Principles of Mechanics. Two lectures and one laboratory exercise each week. The laboratory work is guided by especially prepared instructions. Open to students who have completed Physics A, or its equivalent, and who have completed or are taking Mathematics B1. Three semester hours throughout the year.

Physics C1. Electricity and Magnetism—The more general laws of electricity and magnetism are discussed; the practica equations employed in the laboratory are derived and discussed. Text-book: Starling's Electricity and Magnetism. The laboratory work includes the measurement by one or more methods of current, resistance, electromotive force, temperature-coefficients, capacity; a study of the magnetic properties of iron and steel, thermoelectric effects, the use of the electrometer, the Carey Foster bridge, potentiometer, copper voltameter, etc. Open to students who have completed Mathematics B1 and who have completed or are taking Physics B1. Two lectures and one laboratory exercise each week. Three semester hours throughout the year.

Chemistry A. General Chemistry, Elementary—Text and laboratory work. Open to all students. Four semester hours throughout the year.

Chemistry AB. General Chemistry—To supplement the high school course, making the total equivalent to Chemistry A. Open to students who present one unit of chemistry for entrance, provided that unit is accepted by the department of Chemistry as warranting admission to Chemistry AB. Four semester hours in the first semester only.

Chemistry B1. Qualitative Analysis—Analysis of simple mixtures accompanied by lectures and quizzes. Recitations and laboratory work. Open to students who have completed Chemistry A or an equivalent. Four semester hours for one semester, to be taken in either semester.

Chemistry B2. Organic Chemistry—Lectures and quizzes on the hydrocarbons and their derivatives. Laboratory preparation and study of typical organic compounds. Recitations and laboratory work. Open to students who have completed Chemistry A and B1 or an equivalent. Four semester hours for one semester, to be taken in either semester.

Geology A1. General Geology—A general introduction to Geology. Lectures, recitations and laboratory work. Open to students who have completed in college or in high school a year-course in Chemistry. Four semester hours throughout the year.

Geology B5. Metallurgy—Fuels, refractory and cementing materials, metallurgy of iron and steel. Open to those students of Engineering who have completed Chemistry A. Two semester hours in the first semester only.

Economics A. The Elements of Economics—An elementary course in the principles of economics. First semester. An examination of the fundamental principles of economics. Second semester. Application of these principles to practical problems. Throughout the course special attention is given to the relation between theory and practice. Open to students who have thirty hours of credit. Three semester hours throughout the year.

English B1. Brief Survey of English Literature—Lectures, recitations, written reports, and reading. Open to students who have completed the required English of the first year. Two semester hours throughout the year.

English B2. Masterpieces of English Poetry.—First semester —Chaucer, Marlowe, Shakespeare, Milton. Second semester— The chief poets of the eighteenth and nineteenth centuries. Lectures, recitations, written reports and a considerable amount of reading. Open to students who have completed the required English of the first year. Two semester hours throughout the year.

Electives—Six semester hours of electives are provided for in the senior year of the Mechanical and Electrical Engineering course and four in the fifth year. In the fifth year of the Civil Engineering course six hours of electives are required. These electives are limited to courses given in the College of Liberal Arts, the choice to be approved by the Director.

Elective in Geology—Six hours of elective work limited to the courses in Geology given in the College of Liberal Arts, are required in the senior year of the Civil Engineering course.

Engineering A1. Mechanical Drawing—An elementary course in the technique of mechanical drawing, requiring no previous knowledge of drawing. Freehand lettering, exercise drawing, freehand sketching, shop drawing in pencil, tracing in ink on tracing cloth, machine sketching, isometric and cabinet drawing. Open to all students. Two afternoons a week. Two semester hours for one semester, to be taken in either semester.

Engineering A2. Freshman Shop Work—A series of elementary practical exercises in the shop, upon a wide variety of subjects, the object being to bring out the principles involved, to acquaint the student with a considerable range of mechanical experience and to cultivate habits both of logical thinking and of accurate work. The exercises involve some wood turning, pattern making, filing, scraping, sawing, punching, riveting, brazing, metal turning, shaping, planing, milling, grinding, etc. These exercises are guided by assigned readings, blue-printed instructions and by lectures on mechanical principles and processes, with occasional written work. Open to all students. Two afternoons a week. Two semester hours for one semester, to be taken in either semester.

Ordinarily it is expected that an engineering student will take Engineering A1 in one semester and Engineering A2 in the other semester of his freshman year.

Engineering B1. Sophomore Shop Work—This is a more intensive course than Engineering A2, limited mainly to pattern work, machine work, and tool making. The work is upon problems rather than exercises, and in them the student is given an opportunity to show his ingenuity and his grasp of the subject; while his work is directed in a general way, he is not given detailed instructions. The objects made are generally parts of some machine; this emphasizes the need for accuracy and gives a practical turn and interest to the subject. The work naturally introduces the student to a somewhat advanced knowledge of machines and processes. Open to students who have completed Engineering A2. One afternoon each week. One semester hour throughout the year.

Engineering B2. Surveying—The use of chains, tapes, compass, level, transit, and plane table; methods of land, topographic and hydrographic surveying, including stream measurement, mine surveying and city surveying. Text-book: Theory and Practice of Surveying, by J. B. Johnson and L. S. Smith. Open to students who have completed Engineering A1 and Mathematics A3. Two recitations and one half day in the field each week. Three semester hours throughout the year.

Engineering B3. Summer Surveying—Applications under actual field conditions of the theory taught in Engineering B2. The outcome of the work will be a map of the region covered by the survey and much allied information. A new area will be covered each year, ordinarily adjacent to the area surveyed in the preceding year. The survey camp in 1911 was established in the Fox Lake region in Illinois, near Antioch. Six weeks immediately following commencement. Open to students who have completed Engineering B2. Credit six semester hours.

Engineering C1. Descriptive Geometry, Kinematics and Graphical Statics—The course is divided into three equal parts. (1) Descriptive Geometry; first principles; point, line and plane; curved lines and surfaces; plane sections and developments; intersections of surfaces. Text-book: Essentials of Descriptive Geometry by Phillips and Millar. (2) Kinematics; elementary propositions; communication of motion by rolling and sliding contact, by link work, by wrapping connectors; trains of mechanism; aggregate combinations. Text-book: Elementary Mechanism by Stahl and Woods. (3) Graphical Statics: general principles; concurrent and non-concurrent forces; moments; center of gravity of areas; moment of inertia; roof trusses; loads; reactions; stresses; wind load stresses; cantilever and unsymmetrical trusses; counterbracing; three-hinged arch; transverse bent. Text: Graphic Statics, by Malcolm. Open to students who have completed Engineering A1 and Mathematics A3. One recitation period and two half days of drawing each week. Three semester hours throughout the year.

Engineering D1. Contracts and Specifications—The course deals with contracts and specifications as applied to engineering only. Recitations and lectures. Text-book: Engineering Law by Alexander Haring. Open to students who have sixty hours of credit. Two semester hours in the second semester only.

Engineering D2. Journal Meeting—The time is spent in reading and reviewing current engineering literature, the object being to acquaint the student with this fund of information, to show him the necessity of judicious selection from the great mass of such current literature, to indicate methods of selection, and to cultivate a habit of accurate reading. Open to students who have taken or who are taking Engineering D3, D4, D5 or D6. One afternoon each week. One semester hour throughout the year.

Engineering D3. Structural Mechanics—The text-book work is upon the application of mechanics to the elementary parts of structures, taking up properties of materials, testing materials, elementary theory of elasticity, stresses and strains of beams, columns, shafts, tubes, curved bars, springs and bodies in rapid rotation; stability of piles and retaining walls; elementary theory of reinforced concrete. The laboratory work relates partly to standard methods of testing materials such as steel and cement, but it is largely involved in an effort to bring to the clear comprehension of the student the various relations deduced in the text-book work upon the subject. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering D4. Heat Engines—A course in prime movers and general power plant equipment. Elementary thermodynamics. Construction and operation of steam engines, turbines and gas engines. Engine testing. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours in the second semester only.

Engineering D5. Electrical Machinery—A course in Direct and Alternating Current Machines. Special emphasis is placed upon the study of the fundamental principles involved and upon the application of these principles in practice. Electrical testing. Open to students who have completed Mathematics B1 and Physics C1. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering D6. Electrical Engineering—First semester—A general study of the fundamental principles of Electrical Engineering and their applications to direct current machinery. A selected series of problems are assigned to illustrate quantitatively the principles involved. Second semester—A general study of the fundamental principles of single and polyphase alternating currents, with special reference to analytic, graphic and symbolic methods of treatment. Elementary analysis of alternating current machinery. Open to students who have completed Physics C1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E1. Thermodynamics—The course consists of text-book work first upon the general theory of thermodynamics, and later upon its application to heat engines, taking up properties of gases, flow of gases, thermodynamics of air engines, internal combustion engines and air compressors, properties of steam and other vapors, thermodynamics of steam engines and steam turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Four semester hours in the first semester only.

Engineering E2. The Public Relations of Engineers—A course of lectures and reading dealing with the relations of a practicing engineer to other men. It will deal in part with biographies of engineers, the history of engineering, the purpose of organization and the conservation of natural resources. Open to students who have taken or who are taking Engineering E1, E3, E4, E5, E6, E8 or E9. Two semester hours in the second semester only.

Engineering E3. Engines—A detailed study of the steam engine, steam turbine, boiler plant equipment, gas engines and producer gas plants. Open to students who have taken or who are taking Engineering E1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E4. Hydraulic Engineering—The theory and application of the principles of hydrostatics and hydrodynamics; measurements of flow by pressure gages, meters, Pitot tubes and weirs; path, energy and impulse of jets; flow through orifices, tubes and pipes with loss of energy or head due to contractions, expansions and nozzles; derivation and application of formulæ for discharge, velocity and pressure; work derived from moving vanes as in water wheels and turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E5. Advanced Electrical Engineering—Advanced analysis by the analytic, symbolic and graphic methods of treatment of alternating current machinery, of general alternating current and of transient phenomena. Lectures, assigned reading, recitations and laboratory work. Open to students who have completed Engineering D6. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering E6. Electric Power Plant Engineering—A study of special problems in connection with the generation and transmission of electrical energy in large systems and in high potential systems. Emphasis is laid upon the proper relation of parts to form a complete plant. Lectures, assigned reading, recitations and laboratory work. Open to students who have completed Engineering E5. Two recitations and one laboratory period each week. Three semester hours in the second semester only.

Engineering E7. Thesis—Open to students in the last year in the Engineering course. Two semester hours in the first and four in the second semester.

Engineering E8. Bridges—A general course on the theory and design of bridges, taking up stone arches, reinforced concrete arches, culverts and steel bridges of many types. Open to students who have completed Engineering D3. Three recitations and two half days of drawing each week. Five semester hours in the second semester only.

Engineering E9. Structures—A general course on the theory and design of foundations, retaining walls, tall chimneys, masonry dams and building construction. Open to students who have completed Engineering D3. Three recitations and two half days of drawing each week. Five semester hours in the first semester only.

Engineering E10. Railroad Engineering—The use of the transit, chain, level, etc., in laying out simple, compound and vertical curves; methods of reconnaissance, preliminary and location surveys; turnouts, switches and wye tracks; profile and cross section surveys, and computation of earthwork; haul and mass diagrams; maps and drawings; the use of topographic surveys in location; drainage, waterways and bridge staking. Economic theory of railway location, construction, extension and maintenance. Field work consists of laying out a short line and of the practical application of methods of staking, computation and mapping given above. Open to students who have completed Engineering B2 and Mathematics B1. Three recitations and one half day in the field each week. Four semester hours in the first semester only.

General Regulations

REGISTRATION

Every student is required to register in person at the office of the Registrar, College of Engineering, before entering upon college work, on the registration days specified in the calendar. Returning students who register after the close of this period are subject to a fee of two dollars.

On the registration days of the first semester the student must register for the work of the whole year. Changes may be made only with the consent of the Director. A course dropped without consent is regarded as a failure and is so recorded.

At the time of registraton the student obtains from the Registrar his tuition bill for the semester. This must be presented immediately at the Business Manager's Office for payment.

CLASSIFICATION

Students in the College of Engineering are grouped in five classes according to their credits in the office of the Registrar. The basis for their classification is as follows:

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first four years, and who have satisfied all entrance requirements, are classed as fifth year students.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first three years, and who have satisfied all entrance requirements, are classed as seniors.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first two years, and who have satisfied all entrance requirements, are classed as juniors.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first year, and who have satisfied all entrance requirements, are classed as sophomores.

All other regular students are classed as freshmen, without regard to the date of admission.

GRADES OF SCHOLARSHIP, EXAMINATIONS, AND ATTENDANCE

In other matters of student regulation, such as examinations, grades of scholarship, class and chapel attendance, and physical training, the students of the College of Engineering are governed by the regulations stated in the general University Catalogue and in the Undergraduate's Manual.

FEES AND EXPENSES

Registration Fee, paid by every student at the beginning of each semester	$ 5.00
Tuition and Incidentals, per year, except for Fifth Year students	110.00
Tuition and Incidentals, per year, for Fifth Year students	40.00

Tuition and Incidentals are payable one-half at the beginning of the first semester, one-half at the beginning of the second.

Laboratory Fees

Chemistry A	$7.50 a semester
Chemistry B1 or B2	9.00 a semester
Geology A1	2.00 a semester
Physics A or B1	2.00 a semester
Physics C1	3.00 a semester
Engineering A1	6.00 a semester
Engineering A2	8.00 a semester
Engineering B1	4.00 a semester
Engineering B2 or D3	5.00 a semester
Engineering C1, D4, D5, D6, E3, E4, E5, E6, E8, E9 or E10	3.00 a semester
Student Enterprise Fee	2.50 a semester
Fee for summer surveying course, Engineering B3	15.00
Diploma Fee	10.00

The laboratory fees for engineering courses are intended to cover ordinary depreciation of apparatus and the use of materials. The student is held responsible for any damage due to his negligence.

Laboratory fees are not refunded if the student continues in a course as long as two weeks, except that in the Chemical Laboratory the fee is in the nature of a deposit, and an account is kept of the material used, the unexpended balance at the end of the year being returned to the student.

The tuition fees will not be refunded except in case of sickness. If a student withdraws before the middle of the semester, on account of serious illness, one-half of his tuition fee will be refunded, on his obtaining from the Director a statement of honorable standing, and from a physician a certificate that his health will not permit him to remain in attendance.

Reduced rates of tuition are given to sons of clergymen who are actively pursuing the work of the ministry ($33.00 per semester) and to holders of old-time perpetual or transferable scholarships, for incidentals ($32.50 per semester).

The remaining necessary expenses of a student, namely, board, room, laundry, text-books and stationery, for nine months, vary from $240 to $440, the average being about $310.

Students find comfortable homes in private families or live in clubhouses under their own management. Clubs are formed in which the cost of table board is reduced to a minimum.

SCHOLARSHIPS

A few scholarships, which cover tuition, are awarded annually (four in 1912-1913) to select members of the incoming class, upon applications endorsed by the principal and faculty of the secondary school from which the applicant graduates. The applicant must meet the full entrance requirements and must present certificates from the teachers in his secondary school for excellence of character and scholarship, for physical vigor, manliness and promise of usefulness as a citizen. The award is made at the University by a committee of the College faculty.

A few scholarships, which cover tuition, are awarded annually (four in 1912-1913) to select members of the upper classes.

The upper class scholarship known as the *Swift Scholarship* was offered by Mrs. Gustavus F. Swift to members of the upper classes for the years 1911-1912 and 1912-1913.

OPPORTUNITIES FOR SELF-HELP

Some students in Evanston have been able, while in college, to earn the cost of their living in full, and every year a large percentage earn a considerable portion of their expenses, and at the same time maintain a high standing in their studies. It is never advisable, however, for a student to undertake more work of this kind than is necessary for his personal support, and if the amount is excessive, he should plan to give more than the normal five years to his college course.

The General Secretary of the Young Men's Christian Association maintains a bureau to assist students in finding employment. The positions most frequently open to young men are those as waiters at boarding places or as attendants in private houses in the care of gardens or furnaces. While the aggregate of the annual earnings of students is a large sum, the number of positions open is limited and no assurances can be given that employment will be found. Only the most faithful and self-reliant students should undertake self-support, and in no case should a student come to Evanston without sufficient means to meet expenses for at least a half-year.

RELIGIOUS AND SOCIAL LIFE OF STUDENTS

The charter of the University provides that "no particular religious faith shall be required of those who become students of this institution." Students are expected to attend public worship on Sunday in the church of their choice. Chapel service is held at ten o'clock on each week day, except Saturday, throughout the college year. Attendance upon at least three-fifths of these services is required. Under the direction of the Young Men's Christian Association religious meetings are held each week.

In athletics, in social life and in the use of the buildings, there is no separation of the students of Engineering from the students of Liberal Arts. Engineering students go to the various buildings of the College of Liberal Arts for recitations in other than strictly engineering subjects. They share in the use of the University Library. They have free access to the new gymnasium, the largest in the United States. Their social life is mingled with that of the Liberal Arts students in one university group.

The Engineering Society, composed of students of engineering and members of the engineering faculty, provides numerous addresses by prominent engineers, and organizes inspection trips to points of engineering interest. The members also furnish many additional programs so that the society holds a meeting nearly every week.

Some Advantages of the College of Engineering at Northwestern University

It offers a thorough professional course rather than a purely practical course. It places the emphasis on the fundamentals which are common to all branches of engineering. It trains its graduates for unlimited growth as engineers and for possible leadership.

The engineering courses, five years in length, are so arranged as to give each man his general broad training at the same time that he pursues his engineering studies. The engineering students are closely associated with the larger group of Liberal Arts students, of which they, in fact, form a part.

In the purely engineering part of the course, the proportion of professors to students is much larger than is customary and each student, therefore, receives an unusual amount of attention.

There is more engineering in progress within fifty miles of the loop district of Chicago than in any area of the same size anywhere in the United States with the possible exception of New York City. The students of this College thus have an unsurpassed opportunity to keep in touch with engineering practice and to meet engineers.

The College of Engineering is a new organization not hampered by traditions, and is thus in an excellent condition to take advantage of the experience of other colleges in training engineers.

It is provided with new equipment and with a new excellent building of ample size to meet present requirements.

Inquiries for further information, requests for the catalogue of the University, for scholarship application blanks, and for blank forms of certificates from secondary schools may be addressed to John F. Hayford, Director, College of Engineering, Northwestern University, Evanston, Illinois.

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1851

Northwestern University

¶ THE COLLEGE OF LIBERAL ARTS, located at Evanston, in an ideal college community, offers special preparation for the professions and for pursuits requiring broad training.

¶ THE MEDICAL SCHOOL is one of the oldest, largest, and best equipped. Seven hospitals are open to students. Clinic material is abundant.

¶ THE LAW SCHOOL, the oldest law school in Chicago, offers unexcelled library facilities and special courses that prepare for immediate practice in any state upon graduation.

¶ THE COLLEGE OF ENGINEERING has its own building just completed, beautifully situated, a model of efficiency. Offers courses in all branches of Engineering. Technical studies in a University environment.

¶ THE SCHOOL OF PHARMACY offers a scientific training in Pharmacy, Chemistry and Drug and Food Analysis. Special courses for Drug Clerks.

¶ THE DENTAL SCHOOL offers expert training in theory and practice. Facilities are unsurpassed. Its clinic is the largest in the world.

¶ THE SCHOOL OF MUSIC affords a scientific preparation for music as an accomplishment and a profession. It is located at Evanston.

¶ THE SCHOOL OF COMMERCE provides instruction in economics, elementary and corporation finance, commercial law and accounting. Many lecturers from business and professional life.

¶ EVANSTON ACADEMY prepares for college, for engineering, for professional schools and for business.

For information regarding any school of the University, address President A. W. Harris, Northwestern University Building, Chicago.

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Northwestern University Bulletin

THE LIBRARY OF THE
JUN 1 1931
UNIVERSITY OF ILLINOIS

COLLEGE *of* ENGINEERING ANNOUNCEMENTS
1914-1915

1851

Published Weekly by Northwestern University
Northwestern University Building
CHICAGO

Vol. XIV, No. 29 April 3, 1914

NORTHWESTERN UNIVERSITY

Special Advantages of the New College of Engineering

A thorough professional course rather than a purely practical one, with five years of broad training.

Small classes in which each student receives an unusual amount of individual attention.

A splendid new building designed for the purpose, with entirely new apparatus.

Accessibility to great engineering projects, with unsurpassed opportunities to meet engineers and keep in touch with engineering practise.

A new organization unhampered by embarrassing traditions.

Northwestern University Bulletin

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SWIFT HALL OF ENGINEERING

Swift Hall of Engineering, the gift of Mrs. Gustavus F. Swift and her son, Edward F. Swift, was dedicated in 1909. The building measures fifty-eight by one-hundred and twenty.six feet; the exterior is of Bedford limestone, and presents architectural lines that are of the best; the interior is a model of appropriate decoration, convenience, safety and strength; it has concrete floors and stairways throughout. It presents five working stories, all well lighted and of good height, while the large rooms at the ends of the building are free from columns. From the beginning, it was especially planned as the home of the College of Engineering. The building is in a delightful location overlooking Lake Michigan.

Faculty

ABRAM WINEGARDNER HARRIS, Sc.D., LL.D.
President

JOHN FILLMORE HAYFORD, C.E.
Director

OLIN HANSON BASQUIN, Ph.D.
Professor of Applied Mechanics

WILLIAM CHARLES BAUER, B.S., Sc.D.
Professor of Electrical Engineering

HERBERT SHAW PHILBRICK, B.A., B.S.
Professor of Mechanical Engineering

WILLIAM HENRY BURGER, B.S.
Assistant Professor of Civil Engineering

MILBY ROY HAMMER, B.S.
Associate Professor of Drawing

JAMES TAFT HATFIELD, Ph.D.
Professor of German Language and Literature

HENRY CREW, Ph.D.
Professor of Physics

EDOUARD PAUL BAILLOT, L.H.D.
Professor of Romance Languages

ULYSSES SHERMAN GRANT, Ph.D.
Professor of Geology

ARTHUR CHARLES LEWIS BROWN, Ph.D.
Professor of English Literature

WILLARD EUGENE HOTCHKISS, Ph.D.
Professor of Economics

DAVID RAYMOND CURTISS, Ph.D.
Professor of Mathematics

WALTER LICHTENSTEIN, Ph.D.
Librarian

ROBERT RICHARDSON TATNALL, Ph.D.
Associate Professor of Physics

MURRAY ARNOLD HINES, Ph.D.
Assistant Professor of Chemistry

CLARENCE STEPHEN MARSH, B.A.
Registrar

JESSIE ERSKINE MOSCRIP, B.A.
Assistant Registrar

ANDREWS ALLEN, C.E.
Lecturer on Contracts and Specifications

ELMER MARTIN LIESSMANN, LL.B.
Lecturer on Contracts and Specifications

IVAN HERBERT SPOOR, B.S.
Shop Assistant

Calendar

1914-1915

1914	
Sept. 21, Mon.	Academic year 1914-1915 begins; examinations for admission; first day of registration
Sept. 23, Wed.	Second examinations
Sept. 24, Thu.	Class work begins
Nov. 26, Thu.	Thanksgiving Recess, to November 29, Sunday, inclusive
Dec. 23, Wed.	Christmas Recess, to January 4, Monday, inclusive
1915	
Jan. 5, Tues.	Class work resumed
Jan. 25, Mon.	Mid-year examinations begin
Feb. 5, Fri.	Additional examinations
Feb. 6, Sat.	Last day of Registration for Second Semester
Feb. 6, Sat.	Second examinations
Feb. 8, Mon.	Class work resumed
Apr. 2, Fri.	Easter Recess, to April 5, Monday, inclusive
Apr. 5, Mon.	Second examinations
May 24, Mon.	Regular examinations begin
June 4, Fri.	Additional examinations
June 9, Wed.	FIFTY-SEVENTH ANNUAL COMMENCEMENT
June 10, Thu.	Beginning of summer surveying
July 21, Wed.	End of summer surveying

Historical Note

THE charter of Northwestern University was signed by the Governor of Illinois on January 28, 1851. The corporation consists of forty-four trustees. An amendment to the charter provides that no intoxicating liquors shall be sold within four miles of the University.

The trustees selected as the seat of the University a tract of land on the shore of Lake Michigan, twelve miles north from the heart of Chicago. Here in 1855 the first University building was erected and about its location has grown up the City of Evanston. Here are the College of Liberal Arts, the College of Engineering, the School of Music, and the School of Oratory. The schools of Medicine, Law, Pharmacy, Dentistry and Commerce are located in the City of Chicago.

The College of Liberal Arts, the oldest department of the University, was opened to students in the fall of 1855. From its small beginning it has grown, not by rapid expansion or by large benefactions, but by steady gains along conservative lines—each of its fifty-nine years adding some improvements to its physical and educational equipment. The work of the College of Liberal Arts is mainly directed toward furnishing opportunities for a liberal culture or general education. The regulations affecting the choice of studies are such that the student may elect a large part of his work along lines in which he is especially interested.

In recent years a demand for instruction in engineering gradually made itself felt. A gift for the erection of an engineering building at Evanston and for its endowment led the Trustees of the University to take action in June, 1907, resulting in the establishing of a College of Engineering. This gift came from Mrs. Gustavus F.

Swift and her son, Edward F. Swift. The building, known as the Swift Hall of Engineering, was dedicated in May, 1909. It is now occupied by the College of Engineering. The Department of Mathematics of the College of Liberal Arts also has offices and recitation rooms in the building.

In 1913-1914, the College of Engineering had a total registration of eighty-two students.

STATEMENT OF PURPOSE

The purpose of the College of Engineering of Northwestern University is to furnish to each student a thorough training for the profession of engineering, combined with a general training of the man. The College aims to train engineers for the greatest average effectiveness in a lifetime rather than for the greatest effectiveness in the first year after graduation. It aims to develop a capacity for unlimited growth. Hence strong emphasis is laid on those studies which tend to develop the man as well as on those which furnish training in engineering.

In keeping with these ideals, the courses in engineering introduce an unusual number of those non-technical studies that serve to give a general education and to develop the thinking power of the students. Unusual stress is laid upon Mathematics, upon Physics and other sciences fundamental to engineering and upon the principles which are broadly applicable to all engineering. The courses are five years in length, because past experience among colleges of engineering shows that four years is too short a time for the thorough professional training contemplated. At the end of four years the student of engineering will have secured as thorough a general training as one who comes to Northwestern University for general training alone. In recognition of that fact, he will be given the degree of Bachelor of Science by the College of Liberal Arts. During the fifth year the general training of the student is continued and he completes his professional course in engineering.

The motto of the College is "Culture for Usefulness." This motto calls for an effort to obtain for the student the broadest culture attainable in five years in order to equip him, as a man and as an engineer, for the greatest possible usefulness in the world in the united struggle of man for progress.

Requirements for Admission

Candidates for admission without entrance conditions must qualify by examination or by certificate on fifteen units of High School work. The unit is a course of study requiring a daily recitation on a prepared topic for a full school year, and covering in the various subjects the work defined in the University Catalog.

The subjects which may be presented for admission credit and the number of units acceptable in each are shown in the following table:

English, three units; Algebra, one and a half units; and Plane Geometry, one unit, are required of all candidates. A choice is allowed in the selection of other subjects, but the choice must include either four units of foreign language or two units of foreign language plus two units chosen from the following group: College Algebra one-half unit, Plane Trigonometry one-half unit, Solid Geometry one-half unit, Physics one unit, Chemistry one unit, Manual Training one or two units, and Mechanical Drawing one or two units. The choice of foreign language is limited to Latin, Greek, French, German and Spanish and to a certain maximum number of units in each as indicated in the table which follows. A single unit of any language will be accepted only when accompanied by at least three units of some other language or two units each of two others. The remaining five and one-half units required to make an aggregate of fifteen units may be selected at will from the subjects listed in the following table.

Latin	2, 3 or 4 units
Greek	2 or 3 units
German	2 or 3 units
French	2 or 3 units
Spanish	2 units
College Algebra	½ unit
Plane Trigonometry	½ unit
Solid Geometry	½ unit
Physiography	1 unit
Physics	1 unit
Botany	1 unit
Zoology	1 unit
Chemistry	1 unit
Ancient History	1 unit
Mediæval and Modern History	1 unit
English History	1 unit
American History (or with Civil Government)	1 unit
Civil Government	½ unit
Political Economy	½ unit
Commercial Geography	½ unit
Commercial Law	½ unit
Physiology	½ unit
Mechanical Drawing	1 or 2 units
Manual Training	1 or 2 units
Subjects not specified	2 units

Under the heading "Subjects Not Specified" other topics may be presented, at the discretion of the Board of Examiners. Subjects enumerated above as full units may be presented as half units, or may be presented in excess of the amounts stated, only under this heading and such credit will be thus limited to two units.

One unit of entrance credit in Mechanical Drawing may be given for twelve hours work per week for a full school year, or an equivalent amount of time, provided the work is of an acceptable character. A second unit of credit may be given in Mechanical Drawing only in case the course in drawing taken in school covers the full equivalent of the course Engineering A1 of the College of Engineering.

One unit of entrance credit in Manual Training may be given for twelve hours work per week for a full school year, or an equivalent amount of time, provided the work is of an acceptable character. A second unit of credit may be given in Manual Training only in case the course in Manual Training taken in school covers the full equivalent of the course Engineering A2 of the College of Engineering.

For a statement in detail of the definitions of other entrance units consult the Catalog of the University.

Each student in engineering who has not presented Solid Geometry for entrance will be required to take Solid Geometry, three hours for one semester, in the first year. As this will be an extra task, making it difficult for the student to keep up with his class, each candidate is advised to present this subject for entrance if possible.

So, too, there are various other ways in which a student in meeting the entrance requirements may by his selection of the subjects presented either lighten his later college work, or may so handicap himself as to make it difficult to secure an engineering degree in five years. For a general suggestion on this point, consult page 12.

A candidate may be admitted to the College of Engineering as a regular student with not more than two units of condition, but entrance conditions, if any, must be made up during the first year of residence.

Admission to the College of Engineering may be by certificate or by examination. Candidates for admission must be at least sixteen years of age. Graduates of accredited academies or high schools should obtain certificates of work done, showing the ground covered and the grade received in each study. These certificates should be sent to the Registrar, College of Engineering, at least one week before the opening of the fall semester. It is advisable to send them in much earlier. Certificate blanks may be had on request. Candidates who cannot present such certificates may be admitted on examination. Examinations for this purpose will be held September 21, 1914. The Board of Examiners will accept, in lieu of its examinations, those conducted by the College Entrance Examination Board. This Board holds examinations in June in the Northwestern University Building in Chicago, and at various other places in the United States.

ADVANCED STANDING

Students from other colleges seeking admission to this college must present evidence of honorable dismissal from the institution last attended and must present certificates showing (1) a full record of the applicant's preparation for college, (2) his college record, subject by subject, with the grade obtained in each subject and the year of the course in which it was taken. He should submit a catalog of his college, bearing his name, and of the issue current at the time of his admission to that college. Students from other colleges must first meet the entrance requirements to this college, after which the amount of advanced credit to be obtained by certificate will be estimated by a committee of the Faculty, but not finally placed to his credit until the student has been in residence in this college for one semester. Advanced credit without examination will be given only for work done in an approved college. Claims for advanced credit must be made during the first year of residence and not later than September of the collegiate year in which the candidate expects to graduate.

College credit for work done in a secondary school in excess of the requirements for admission can be given only on examination provided through the Registrar's office, and on the basis of five semester hours of credit for one unit of work. An exception to the examination rule is made in foreign language subjects continued in college during the first year, where the subsequent work is a sufficient test of the quality of the earlier work. Applications for such credit and for examination must be made to the Registrar during the first semester of residence and the examination must be taken at one of the regular dates set, viz.: the Wednesday of the opening week in September, the Saturday following regular examinations in February, or the Monday following Easter. Advanced credit can be allowed only in Mathematics, foreign languages, or such other subjects taken in the last year of the secondary school course as may be approved by the Committee on Advanced Standing. No examination for advanced credit will be allowed after the first year of residence nor in subjects foreign to the college curriculum.

Courses of Study

The College of Engineering offers two courses of study, each five years in length, one in Mechanical and Electrical Engineering and the other in Civil Engineering. These courses are alike in character and the same in content to the end of the third year.

For the satisfactory completion of the first four years of either course, the degree, Bachelor of Science, will be given by the College of Liberal Arts.

The degree, Electrical Engineer, will be given by the College of Engineering at the end of the five-year course in Mechanical and Electrical Engineering, and the degree, Civil Engineer, at the end of the five-year course in Civil Engineering.

COURSE IN MECHANICAL AND ELECTRICAL ENGINEERING

	Semester Hours	
Freshman Year	First Semester	Second Semester
English A1	3	3
French A	3	3
Physics A	4	4
Mathematics A3	5	5
Mechanical Drawing, Engineering A1, or Shop Work, Engineering A2	2	..
Mechanical Drawing, Engineering A1, or Shop Work, Engineering A2	..	2
Summer Work	..	2
Sophomore Year		
German A	3	3
Physics B1	3	3
Calculus, Mathematics B1	3	3
Chemistry A	4	4
Surveying, Engineering B2	3	3

	Semester Hours First Semester	Semester Hours Second Semester
Shop Work, Engineering B1	1	1
Summer Surveying, Engineering B3	..	6
Junior Year		
Economics A	3	3
Physics C1	3	3
Chemistry B1	4	..
Chemistry B2	..	4
Geology A1	4	4
Descriptive Geometry, Kinematics, and Graphical Statics, Engineering C1	3	3
Summer Work	..	2
Senior Year		
English B	2	2
Structural Mechanics, Engineering D3	3	3
Calculus, Mathematics C1	3	3
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Electrical Engineering, Engineering D6	3	3
Elective	3	3
Summer Work	..	2
Fifth Year		
Hydraulic Engineering, Engineering E4	3	3
Thermodynamics, Engineering E1	4	..
The Public Relations of Engineers, Engineering E2	..	2
Thesis, Engineering E7	2	4
Engines, Engineering E3	3	3
Advanced Electrical Engineering, Engineering E5	3	..
Electric Power Plant Engineering, Engineering E6	..	3
Elective	2	2

COURSE IN CIVIL ENGINEERING

The first three years of this course are the same as those in the course in Mechanical and Electrical Engineering shown above.

	Semester Hours	
Senior Year	First Semester	Second Semester
English B	2	2
Structural Mechanics, Engineering D3	3	3
Calculus, Mathematics C1	3	3
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Electrical Machinery, Engineering D5	3	..
Heat Engines, Engineering D4	..	3
Elective in Geology	3	3
Summer Work	..	2
Fifth Year		
Hydraulic Engineering, Engineering E4	3	3
Railroad Engineering, Engineering E10	4	..
The Public Relations of Engineers, Engineering E2	..	2
Thesis, Engineering E7	2	4
Structures, Engineering E9	5	..
Bridges, Engineering E8	..	5
Elective	3	3

Each course contains seventeen semester hours of credit each semester, exclusive of summer work.

Each course may be taken precisely as shown above by a student who enters the College with the standard preparation which includes English three units, Algebra one and one-half units, Plane Geometry one unit, Solid Geometry one-half unit, French two units, and German two units. If however the student enters College deficient in any of the subjects enumerated in the preceding sentence and the deficiency is not counterbalanced by excess elsewhere in his preparation of the character indicated later in this paragraph, it will be impossible for him to complete either engineering course in five years without securing more than an average of seventeen semester hours of credit in each semester. Only an exceptionally strong student may expect to secure more than seventeen hours of credit per semester. Certain subjects when accepted for entrance credit constitute an excess in the sense that they relieve the student offering them of some college work which would otherwise be required of him in the engineering courses. These are College Algebra, Plane Trigonometry, Chemistry (if accepted by the department of Chemistry as warranting the student's admission directly to the college course Chemistry AB instead of to Chemistry A), a second unit of Mechanical Drawing, a second unit of Manual Training, and such preparation in foreign language as will leave the student less than twelve semester hours of foreign language to be taken in college in order to meet the requirements for the degree of Bachelor of Science which are shown in the Catalog of the University. As an example it may be stated that a student who presents three units of German or Latin, and two of French, is required to take in college French A only, six semester hours, instead of both French A and German A as listed above, twelve semester hours.

For recitations or lectures one semester hour of credit is given for one period, fifty minutes, each week during one semester. For shop work, drafting or laboratory work, one semester hour of credit is given for one three-hour period each week during one semester.

During each of the three summers following the first, third and fourth years the student is required to do practical work for at least six weeks, of such a character as to furnish experience of value to him as a prospective engineer. The credit assigned to six weeks of such approved work is two semester hours.

Under this requirement, students have acted as rodmen on city surveys, rodmen on the United States Lake Survey, workers in the tool room of a factory, helpers in the installation of heavy machinery in a new steam-electric power plant, foremen of a gang of laborers, helpers in the wiring of telephone switchboards, assistants in cement testing, computers for the Carnegie Institution, inspectors with a company engaged in electric lighting and power distribution, and have worked on milling and machine work, figuring estimates, making tracings, and on land and topographical surveys.

During the summer following the second year the student is required to do field work in surveying for six weeks immediately following commencement, Engineering B3, credit six semester hours. This is a regular college course under the direction of college professors, taken at a summer camp established for that purpose.

DESCRIPTION OF COURSES

The following paragraphs give more specific information in regard to the separate courses enumerated above as together constituting the courses in Mechanical and Electrical Engineering and in Civil Engineering:

English A1. Composition and Rhetoric. Required of all students in their first year. Three semester hours throughout the year.

English A2. Composition and Rhetoric. Required of students whose preparation is found to be insufficient for English A1. The work of the first semester is continued two hours a week in the second semester and attendance is required until the student's work is brought consistently up to a satisfactory standard.

French A. Modern French. Koren's Composition. Buffum's French Short Stories. Advanced Grammar. Reading. Coppee's On rend l'Argent. Pailleron's Le Monde ou l'on s'Ennuie. Victor Hugo's Quatre-Vingt Trieze. Canfield's French Lyrics. Coppee's Le Pater. Victor Hugo's Hernani. Private reading: Cameron's Selections from Loti. Three semester hours throughout the year. Open to students who present two units of French for entrance. If the student has presented no French for entrance he must take French AA, five semester hours throughout one year, in college before being admitted to French A, or if he has presented one unit of French for entrance, he must ordinarily take French AB, three semester hours throughout one year, in college before being admitted to French A.

German A. Intermediate German—Some sections take modern prose writers, Storm, Freytag, Seidel, Hoffmann, Ernst, etc. German lyrics and ballads. Other sections take Lessing's Minna von Barnhelm, German lyrics and ballads, Schiller's Wilhelm Tell and Maria Stuart, Lessing's Nathan der Weisse. Three semester hours throughout the year. Open to students who present two units of German for entrance. If the student has presented no German for entrance he must take German AA, five semester hours throughout one year, in college before being admitted to German A, or if he has presented one unit of German for entrance he must ordinarily take German AB, three semester hours throughout one year, in college before being admitted to German A.

If the student has offered for entrance two units of French and two of German, he is advised to take French A in the first year and German A in the second year, but the order may be reversed. If other language units than those named in the preceding sentence have been offered for entrance, the student is required to take such language courses as will satisfy the language requirement for the degree of Bachelor of Science. These are not necessarily the courses French A and German A. For example, if a student has presented two or three units of Latin or of Greek for entrance he may be released, both as to entrance credits and as to college work, from a part of French or German. For complete information on this point, consult the statement of prescribed courses for the degree of Bachelor of Science, in the University catalog.

Mathematics A3. Plane Trigonometry, Algebra and Analytical Geometry—This is a course in which Plane Trigonometry, Algebra and Analytical Geometry are given together in one continuous course. Open to students who have presented one and a half units of Algebra for admission. Five semester hours throughout the year.

If a student has presented College Algebra or Plane Trigonometry for entrance, instead of taking Mathematics A3 in the freshman year, he is required to take three semester hours in each of two semesters in courses so arranged that with the work offered for entrance they will be equivalent to Mathematics A3.

Mathematics B1. Differential and Integral Calculus. A first course in Calculus, including its simpler applications. Open to students who have completed Mathematics A3, or an equivalent. Three semester hours throughout the year.

Mathematics C1. Advanced Calculus—Infinite series; Taylor's theorem; partial differentiation; differential geometry; definite integrals over curves, surfaces and volumes; the Eulerian functions; Fourier's series; differential equations. Open to students who have completed Mathematics B1. Three semester hours throughout the year.

Physics A. General Physics—First semester—General properties of matter, wave-motion, sound. Second semester—Heat, electricity, magnetism, light. An introductory course requiring no mathematics beyond the requirements for entrance to college, intended to acquaint the student with the elementary facts, the method, and the general principles of physical science. Text-book: Crew's General Physics. Three lectures and one laboratory exercise each week. Open to all students. Four semester hours throughout the year.

Physics B1. Mechanics—An elementary experimental study of forces, moments of force, moments of inertia, elasticity, hydromechanics, an introduction to advanced Physics and Engineering. This is a course in pure Dynamics, and serves as an introduction to Applied Mechanics. Text-book: Crew's Principles of Mechanics. Two lectures and one laboratory exercise each week. The laboratory work is guided by especially prepared instructions. Open to students who have completed Physics A, or its equivalent, and who have completed or are taking Mathematics B1. Three semester hours throughout the year.

Physics C1. Electricity and Magnetism—The more general laws of electricity and magnetism are discussed; the practical equations employed in the laboratory are derived and discussed. Text-book: Starling's Electricity and Magnetism. The laboratory work includes the measurement by one or more methods of current, resistance, electromotive force, temperature-coefficients, capacity; a study of the magnetic properties of iron and steel, thermoelectric effects, the use of the electrometer, the Carey Foster bridge, potentiometer, copper voltameter, etc. Open to students who have completed Mathematics B1 and who have completed or are taking Physics B1. Two lectures and one laboratory exercise each week. Three semester hours throughout the year.

Chemistry A. General Chemistry, Elementary—Text and laboratory work. Open to all students. Four semester hours throughout the year.

Chemistry AB. General Chemistry—To supplement the high school course, making the total equivalent to Chemistry A. Open to students who present one unit of chemistry for entrance, provided that unit is accepted by the department of Chemistry as warranting admission to Chemistry AB. Four semester hours in the first semester only.

Chemistry B1. Qualitative Analysis—Analysis of simple mixtures accompanied by lectures and quizzes. Recitations and laboratory work. Open to students who have completed Chemistry A or an equivalent. Four semester hours for one semester, to be taken in either semester.

Chemistry B2. Organic Chemistry—Lectures and quizzes on the hydrocarbons and their derivatives. Laboratory preparation and study of typical organic compounds. Recitations and laboratory work. Open to students who have completed Chemistry A and B1 or an equivalent. Four semester hours for one semester, to be taken in either semester.

Geology A1. General Geology—A general introduction to Geology. Lectures, recitations and laboratory work. Open to students who have completed in college or in high school a year-course in Chemistry. Four semester hours throughout the year.

Geology B5. Metallurgy—Fuels, refractory and cementing materials, metallurgy of iron and steel. Open to those students of Engineering who have completed Chemistry A. Two semester hours in the first semester only.

Economics A. The Elements of Economics—An elementary course in the principles of economics. First semester. An examination of the fundamental principles of economics. Second semester. Application of these principles to practical problems. Throughout the course special attention is given to the relation between theory and practice. Open to sophomores. Three semester hours throughout the year.

English B. English Literature; Composition—Lectures, recitations, written reports and themes, and reading. Open to students who have completed the required English of the first year. Two semester hours throughout the year.

Electives—Six semester hours of electives are provided for in the senior year of the Mechanical and Electrical Engineering course and four in the fifth year. In the fifth year of the Civil Engineering course six hours of electives are required. These electives are limited to courses given in the College of Liberal Arts, the choice to be approved by the Director.

Elective in Geology—Six hours of elective work limited to the courses in Geology given in the College of Liberal Arts, are required in the senior year of the Civil Engineering course.

Engineering A1. Mechanical Drawing—An elementary course in the technique of mechanical drawing, requiring no previous knowledge of drawing. Freehand lettering, exercise drawing, freehand sketching, shop drawing in pencil, tracing in ink on tracing cloth. Open to all students. Two drawing periods each week. Two semester hours for one semester, to be taken in either semester.

Engineering A2. Freshman Shop Work—A series of elementary practical exercises in the shop, upon a wide variety of subjects, the object being to bring out the principles involved, to acquaint the student with a considerable range of mechanical experience and to cultivate habits both of logical thinking and of accurate work. The exercises involve some wood turning, pattern making, filing, scraping, sawing, punching, riveting, brazing, metal turning, shaping, planing, milling, grinding, etc. These exercises are guided by assigned readings, blue-printed instructions and by lectures on mechanical princi-

ples and processes, with occasional written work. Open to all students. Two shop periods each week. Two semester hours for one semester, to be taken in either semester.

Ordinarily it is expected that an engineering student will take Engineering A1 in one semester and Engineering A2 in the other semester of his freshman year.

Engineering B1. Sophomore Shop Work—This is a more intensive course than Engineering A2, limited mainly to pattern work, machine work, and tool making. The work is upon problems rather than exercises, and in them the student is given an opportunity to show his ingenuity and his grasp of the subject; while his work is directed in a general way, he is not given detailed instructions. The objects made are generally parts of some machine; this emphasizes the need for accuracy and gives a practical turn and interest to the subject. The work naturally introduces the student to a somewhat advanced knowledge of machines and processes. Open to students who have completed Engineering A2. One shop period each week. One semester hour throughout the year.

Engineering B2. Surveying—The use of chains, tapes, compass, level, transit, and plane table; methods of land, topographic and hydrographic surveying, including stream measurement, mine surveying and city surveying. Text-book: Theory and Practice of Surveying, by J. B. Johnson and L. S. Smith. Open to students who have completed Engineering A1 and Mathematics A3. Two recitations and one field period each week. Three semester hours throughout the year.

Engineering B3. Summer Surveying—Applications under actual field conditions of the theory taught in Engineering B2. The outcome of the work will be a map of the region covered by the survey and much allied information. A new area will be covered each year, ordinarily adjacent to the area surveyed in the preceding year. The survey camp in 1913 was established in the Fox Lake region in Illinois, near Antioch. Six weeks immediately following commencement. Open to students who have completed Engineering B2. Credit six semester hours.

Engineering C1. Descriptive Geometry, Kinematics and Graphical Statics—The course is divided into three equal parts. (1) Descriptive Geometry; first principles; point, line and plane; curved lines and surfaces; plane sections and developments; intersections of surfaces. Text-book: Essentials of Descriptive Geometry by Phillips and Millar. (2) Kinematics; elementary propositions; communication of motion by rolling and sliding contact, by link work, by wrapping connectors; trains of mechanism; aggregate combinations. Text-book: Elementary Mechanism by Stahl and Woods. (3) Graphical Statics: general principles; concurrent and non-concurrent forces; moments; center of gravity of areas; moment of inertia; roof trusses; loads; reactions; stresses; wind load stresses; cantilever and unsymmetrical trusses; counter-bracing; three-hinged arch; transverse bent. Text: Graphic Statics, by Malcolm. Open to students who have completed Engineering A1 and Mathematics A3. One recitation period and two drawing periods each week. Three semester hours throughout the year.

Engineering D1. Contracts and Specifications—The course deals with contracts and specifications as applied to engineering only. Recitations and lectures. Text-book: The Law of Contracts by John C. Wait. Open to students who have sixty hours of credit. Two semester hours in the second semester only.

Engineering D2. Journal Meeting—The time is spent in reading and reviewing current engineering literature, the object being to acquaint the student with this fund of information, to show him the necessity of judicious selection from the great mass of such current literature, to indicate methods of selection, and to cultivate a habit of accurate reading. Open to students who have taken or who are taking Engineering D3, D4, D5 or D6. One laboratory period each week. One semester hour throughout the year.

Engineering D3. Structural Mechanics—The text-book work is upon the application of mechanics to the elementary parts of structures, taking up properties of materials, testing materials, elementary theory of elasticity, stresses and strains of beams, columns, shafts, tubes, curved bars, springs and bodies in rapid rotation; stability of piles and retaining walls; elementary theory of reinforced concrete. The laboratory work relates partly to standard methods of testing materials such as steel and cement, but it is largely involved in an effort to bring to the clear comprehension of the student the various relations deduced in the text-book work upon the subject. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering D4. Heat Engines—A course in prime movers and general power plant equipment. Elementary thermodynamics. Construction and operation of steam engines, turbines and gas engines. Engine testing. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours in the second semester only.

Engineering D5. Electrical Machinery—A course in Direct and Alternating Current Machines. Special emphasis is placed upon the study of the fundamental principles involved and upon the application of these principles in practise. Electrical testing. Open to students who have completed Mathematics B1 and Physics C1. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering D6. Electrical Engineering—First semester—A general study of the fundamental principles of Electrical Engineering and their applications to direct current machinery. A selected series of problems are assigned to illustrate quantitatively the principles involved. Second semester—A general study of the fundamental principles of single and polyphase alternating currents, with special reference to analytic, graphic and symbolic methods of treatment. Elementary analysis of alternating current machinery. Open to students who have completed Physics C1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E1. Thermodynamics—The course consists of text-book work first upon the general theory of thermodynamics, and later upon its application to heat engines, taking up properties of gases, flow of gases, thermodynamics of air engines, internal combustion engines and air compressors, properties of steam and other

vapors, thermodynamics of steam engines and steam turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Four semester hours in the first semester only.

Engineering E2. The Public Relations of Engineers—A course of lectures and reading dealing with the relations of a practising engineer to other men. It will deal in part with biographies of engineers, the history of engineering, the purpose of organization and the conservation of natural resources. Open to students who have taken or who are taking Engineering E1, E3, E4, E5, E6, E8 or E9. Two semester hours in the second semester only.

Engineering E3. Engines—A detailed study of the steam engine, steam turbine, boiler plant equipment, gas engines and producer gas plants. Open to students who have taken or who are taking Engineering E1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E4. Hydraulic Engineering—The theory and application of the principles of hydrostatics and hydrodynamics; measurements of flow by pressure gages, meters, Pitot tubes and weirs; path, energy and impulse of jets; flow through orifices, tubes and pipes with loss of energy or head due to contractions, expansions and nozzles; derivation and application of formulæ for discharge, velocity and pressure; work derived from moving vanes as in water wheels and turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E5. Advanced Electrical Engineering—Advanced analysis by the analytic, symbolic and graphic methods of treatment of alternating current machinery, of general alternating current and of transient phenomena. Lectures, assigned reading, recitations and laboratory work. Open to students who have completed Engineering D6. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering E6. Electric Power Plant Engineering—A study of special problems in connection with the generation and transmission of electrical energy in large systems and in high potential systems. Emphasis is laid upon the proper relation of parts to form a complete plant. Lectures, assigned reading, recitations and laboratory work. Open to students who have completed Engineering E5. Two recitations and one laboratory period each week. Three semester hours in the second semester only.

Engineering E7. Thesis—Open to students in the last year in the Engineering course. Two semester hours in the first and four in the second semester.

Engineering E8. Bridges—A general course on the theory and design of bridges, taking up stone arches, reinforced concrete arches, culverts and steel bridges of many types. Open to students who have completed Engineering D3. Three recitations and two drawing periods each week. Five semester hours in the second semester only.

Engineering E9. Structures—A general course on the theory and design of foundations, retaining walls, tall chimneys, masonry dams and building construction. Open to students who have completed Engineering D3. Three recitations and two drawing periods each week. Five semester hours in the first semester only.

Engineering E10. Railroad Engineering—The use of the transit, chain, level, etc., in laying out simple, compound and vertical curves; methods of reconnaissance, preliminary and location surveys; turnouts, switches and wye tracks; profile and cross section surveys, and computation of earthwork; haul and mass diagrams; maps and drawings; the use of topographic surveys in location; drainage, waterways and bridge staking. Economic theory of railway location, construction, extension and maintenance. Field work consists of laying out a short line and of the practical application of methods of staking, computation and mapping given above. Open to students who have completed Engineering B2 and Mathematics B1. Three recitations and one field period each week. Four semester hours in the first semester only.

General Regulations

REGISTRATION

Every student is required to register in person at the office of the Registrar, College of Engineering, before entering upon college work, on the registration days specified in the calendar. Returning students who register after the close of this period are subject to a fee of two dollars.

On the registration days of the first semester the student must register for the work of the whole year. Changes may be made only with the consent of the Director. A course dropped without consent is regarded as a failure and is so recorded.

At the time of registration the student obtains from the Registrar his tuition bill for the semester. This must be presented immediately at the Business Manager's Office for payment.

CLASSIFICATION

Students in the College of Engineering are grouped in five classes according to their credits in the office of the Registrar. The basis for their classification is as follows:

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first four years, and who have satisfied all entrance requirements, are classed as fifth year students.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first three years, and who have satisfied all entrance requirements, are classed as seniors.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first two years, and who have satisfied all entrance requirements, are classed as juniors.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first year, and who have satisfied all entrance requirements, are classed as sophomores.

All other regular students are classed as freshmen, without regard to the date of admission.

GRADES OF SCHOLARSHIP, EXAMINATIONS, AND ATTENDANCE

In other matters of student regulation, such as examinations, grades of scholarship, class and chapel attendance, and physical training, the students of the College of Engineering are governed by the regulations stated in the general University Catalog and in the Undergraduate's Manual.

FEES AND EXPENSES

Registration Fee, paid by every student at the beginning of each semester	$ 5.00
Tuition and Incidentals, per year, except for Fifth Year students	110.00
Tuition and Incidentals, per year, for Fifth Year students	40.00

Tuition and Incidentals are payable one-half at the beginning of the first semester, one-half at the beginning of the second.

Laboratory Fees

Chemistry A	$7.50 a semester
Chemistry B1 or B2	9.00 a semester
Geology A1	2.00 a semester
Physics A or B1	2.00 a semester
Physics C1	3.00 a semester
Engineering A1	6.00 a semester
Engineering A2	8.00 a semester
Engineering B1	4.00 a semester
Engineering B2 or D3	5.00 a semester
Engineering C1, D4, D5, D6, E3, E4, E5, E6, E8, E9 or E10	3.00 a semester
Student Enterprise Fee	2.50 a semester
Fee for summer surveying course, Engineering B3	15.00.
Diploma Fee	10.00

The laboratory fees for engineering courses are intended to cover ordinary depreciation of apparatus and the use of materials. The student is held responsible for any damage due to his negligence.

Laboratory fees are not refunded if the student continues in a course as long as two weeks, except that in the Chemical Laboratory the fee is in the nature of a deposit, and an account is kept of the material used, the unexpended balance at the end of the year being returned to the student.

The tuition fees will not be refunded except in case of sickness. If a student withdraws before the middle of the semester, on account of serious illness, one-half of his tuition fee will be refunded, on his obtaining from the Director a statement of honorable standing, and from a physician a certificate that his health will not permit him to remain in attendance.

Reduced rates of tuition are given to sons of clergymen who are actively pursuing the work of the ministry ($33.00 per semester) and to holders of old-time perpetual or transferable scholarships, for incidentals ($32.50 per semester).

The remaining necessary expenses of a student, namely, board, room, laundry, text-books and stationery, for nine months, vary from $260 to $480, the average being about $340.

Students find comfortable homes in private families or live in club houses under their own management. Clubs are formed in which the cost of table board is reduced to a minimum.

DORMITORIES

A new system of eleven dormitories for men students was put into use in 1913-14. Seven of these buildings are designed for fraternities, whose alumni have contributed toward their cost, and the remaining four are open for rental by any of the men students of the University.

The buildings are architecturally beautiful and are meant to be models in comfort and sanitation. They are fireproof, lighted by electricity, and heated by steam. On the first floor of each building is a large enclosed porch, and a well equipped club room with an open

fire-place, rugs, tables, and lounging chairs. There are also a few rooms for individual students on this floor. The second and third floors are made up entirely of single rooms.

Each student's private room is furnished with a single bed, mattress and pillow, a chiffonier, a combined study table and bookcase, two chairs, a rug, and window shades. The student furnishes his own bedding and towels, but the University takes charge of the laundering of these. In the interest of economy, electric lighting is not included in the general charge, but is apportioned pro rata monthly to the occupants of the building.

In the men's dormitories room rent is payable at the beginning of each semester and the charge to each student for the use of a furnished single room, including care, heat and water, is one hundred dollars a year. The rental for private rooms on the first floor is somewhat higher.

The Registrar of the College of Liberal Arts is the renting officer of the dormitories; and men of the freshmen class of the College of Engineering not living at their homes are required to live in the dormitories unless no rooms are available, or they obtain through the Registrar permission to room elsewhere.

SCHOLARSHIPS

A few scholarships, which cover tuition, are awarded annually (four in 1913-1914) to select members of the incoming class, upon applications endorsed by the principal and faculty of the secondary school from which the applicant graduates. The applicant must meet the full entrance requirements and must present certificates from the teachers in his secondary school for excellence of character and scholarship, for physical vigor, manliness and promise of usefulness as a citizen. The award is made at the University by a committee of the College faculty.

A few scholarships, which cover tuition, are awarded annually (four in 1913-1914) to select members of the upper classes.

The upper class scholarship known as the *Swift Scholarship* has been given by Mrs. Gustavus F. Swift to members of the upper classes.

OPPORTUNITIES FOR SELF HELP

Some students in Evanston have been able, while in college, to earn the cost of their living in full, and every year a large percentage earn a considerable portion of their expenses, and at the same time maintain a high standing in their studies. It is never advisable, however, for a student to undertake more work of this kind than is necessary for his personal support, and if the amount is excessive he should plan to give more than the normal five years to his college course.

The General Secretary of the Young Men's Christian Association maintains a bureau to assist students in finding employment. The positions most frequently open to young men are those as waiters at boarding places or as attendants in private houses in the care of gardens or furnaces. While the aggregate of the annual earnings of students is a large sum, the number of positions open is limited and no assurances can be given that employment will be found. Only the most faithful and self-reliant students should undertake self-support, and in no case should a student come to Evanston without sufficient means to meet expenses for at least a half-year.

RELIGIOUS AND SOCIAL LIFE OF STUDENTS

The charter of the University provides that "no particular religious faith shall be required of those who become students of this institution." Students are expected to attend public worship on Sunday in the church of their choice. Chapel service is held at ten o'clock on each week day, except Saturday, throughout the college year. Attendance upon at least three-fifths of these services is required. Under the direction of the Young Men's Christian Association religious meetings are held each week.

In athletics, in social life and in the use of the buildings, there is no separation of the students of Engineering from the students of Liberal Arts. Engineering students go to the various buildings of the College of Liberal Arts for recitations in other than strictly engineering subjects. They share in the use of the University

Library. They have free access to the new gymnasium, the largest in the United States. Their social life is mingled with that of the Liberal Arts students in one university group.

The Engineering Society, composed of students of engineering and members of the engineering faculty, provides numerous addresses by prominent engineers and organizes inspection trips to points of engineering interest. The members also furnish many additional programs so that the society holds a meeting nearly every week.

Some Advantages of the College of Engineering at Northwestern University

It offers a thorough professional course rather than a purely practical course. It places the emphasis on the fundamentals which are common to all branches of engineering. It trains its graduates for unlimited growth as engineers and for possible leadership.

The engineering courses, five years in length, are so arranged as to give each man his general broad training at the same time that he pursues his engineering studies. The engineering students are closely associated with the larger group of Liberal Arts students, of which they, in fact, form a part.

In the purely engineering part of the course, the proportion of professors to students is much larger than is customary and each student, therefore, receives an unusual amount of attention.

There is more engineering in progress within fifty miles of the loop district of Chicago than in any area of the same size anywhere in the United States with the possible exception of New York City. The students of this College thus have an unsurpassed opportunity to keep in touch with engineering practise and to meet engineers.

The College of Engineering is a new organization not hampered by traditions, and is thus in an excellent condition to take advantage of the experience of other colleges in training engineers.

It is provided with new equipment and with a new excellent building of ample size to meet present requirements.

Inquiries for further information, requests for the catalog of the University, for scholarship application blanks, and for blank forms of certificates from secondary schools may be addressed to John F. Hayford, Director, College of Engineering, Northwestern University, Evanston, Illinois.

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For information regarding any school of the University, address President A. W. Harris, Northwestern University Building, Chicago.

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Northwestern University Bulletin

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COLLEGE *of* ENGINEERING ANNOUNCEMENTS
1915-1916

Published Weekly by Northwestern University
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Vol. XV, No. 27 **March 19, 1915**

NORTHWESTERN UNIVERSITY

Special Advantages of the New College of Engineering

A thorough professional course rather than a purely practical one, with five years of broad training.

Small classes in which each student receives an unusual amount of individual attention.

A splendid building designed for the purpose, with entirely new apparatus.

Accessibility to great engineering projects, with unsurpassed opportunities to meet engineers and keep in touch with engineering practise.

A new organization unhampered by embarrassing traditions.

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SWIFT HALL OF ENGINEERING

Swift Hall of Engineering, the gift of Mrs. Gustavus F. Swift and her son, Edward F. Swift, was dedicated in 1909. The building measures fifty-eight by one-hundred and twenty.six feet; the exterior is of Bedford limestone, and presents architectural lines that are of the best; the interior is a model of appropriate decoration, convenience, safety and strength; it has concrete floors and stairways throughout. It presents five working stories, all well lighted and of good height, while the large rooms at the ends of the building are free from columns. From the beginning, it was especially planned as the home of the College of Engineering. The building is in a delightful location overlooking Lake Michigan.

Faculty

ABRAM WINEGARDNER HARRIS, Sc.D., LL.D.
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Director

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Assistant Professor of Civil Engineering

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Associate Professor of Drawing

JAMES TAFT HATFIELD, Ph.D.
Professor of German Language and Literature

HENRY CREW, Ph.D.
Professor of Physics

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Assistant Registrar

ANDREWS ALLEN, C.E.
Lecturer on Contracts and Specifications

ELMER MARTIN LIESSMANN, LL.B.
Lecturer on Contracts and Specifications

IVAN HERBERT SPOOR, B.S.
Shop Assistant

Calendar

1915-1916

1915	
Sept. 20, Mon.	Academic year 1915-1916 begins; examinations for admission; first day of registration
Sept. 22, Wed.	Second examinations
Sept. 23, Thu.	Class work begins
Nov. 25, Thu.	Thanksgiving Recess, to November 28, Sunday, inclusive
Dec. 23, Thu.	Christmas Recess, to January 3, Monday, inclusive
1916	
Jan. 4, Tues.	Class work resumed
Jan. 31, Mon.	Mid-year examinations begin
Feb. 11, Fri.	Second Semester begins. Additional examinations
Feb. 12, Sat.	Last day of Registration for Second Semester
Feb. 12, Sat.	Second examinations
Feb. 14, Mon.	Class work resumed
Feb. 22, Tues.	Washington's birthday
Apr. 21, Fri.	Easter Recess, to April 24, Monday, inclusive
Apr. 24, Mon.	Second examinations
May 29, Mon.	Regular examinations begin
May 30, Tues.	Memorial day
June 9, Fri.	Additional examinations
June 14, Wed.	FIFTY-EIGHTH ANNUAL COMMENCEMENT
June 15, Thu.	Beginning of summer surveying
July 26, Wed.	End of summer surveying

Historical Note

THE charter of Northwestern University was signed by the Governor of Illinois on January 28, 1851. The corporation consists of forty-four trustees. An amendment to the charter provides that no intoxicating liquors shall be sold within four miles of the University.

The trustees selected as the seat of the University a tract of land on the shore of Lake Michigan, twelve miles north from the heart of Chicago. Here in 1855 the first University building was erected and about its location has grown up the City of Evanston. Here are the College of Liberal Arts, the College of Engineering, the School of Music, and the School of Oratory. The schools of Medicine, Law, Pharmacy, Dentistry and Commerce are located in the City of Chicago.

The College of Liberal Arts, the oldest department of the University, was opened to students in the fall of 1855. From its small beginning it has grown, not by rapid expansion or by large benefactions, but by steady gains along conservative lines—each of its sixty years adding some improvements to its physical and educational equipment. The work of the College of Liberal Arts is mainly directed toward furnishing opportunities for a liberal culture or general education. The regulations affecting the choice of studies are such that the student may elect a large part of his work along lines in which he is especially interested.

In recent years a demand for instruction in engineering gradually made itself felt. A gift for the erection of an engineering building at Evanston and for its endowment led the Trustees of the University to take action in June, 1907, resulting in the establishing of a College of Engineering. This gift came from Mrs. Gustavus F.

Swift and her son, Edward F. Swift. The building, known as the Swift Hall of Engineering, was dedicated in May, 1909. It is now occupied by the College of Engineering. The Department of Mathematics of the College of Liberal Arts also has offices and recitation rooms in the building.

In 1914-1915, the College of Engineering had a total registration of eighty-eight students.

STATEMENT OF PURPOSE

The purpose of the College of Engineering of Northwestern University is to furnish to each student a thorough training for the profession of engineering, combined with a general training of the man. The College aims to train engineers for the greatest average effectiveness in a lifetime rather than for the greatest effectiveness in the first year after graduation. It aims to develop a capacity for unlimited growth. Hence strong emphasis is laid on those studies which tend to develop the man as well as on those which furnish training in engineering.

In keeping with these ideals, the courses in engineering introduce an unusual number of those non-technical studies that serve to give a general education and to develop the thinking power of the students. Unusual stress is laid upon Mathematics, upon Physics and other sciences fundamental to engineering and upon the principles which are broadly applicable to all engineering. The courses are five years in length, because past experience among colleges of engineering shows that four years is too short a time for the thorough professional training contemplated. At the end of four years the student of engineering will have secured as thorough a general training as one who comes to Northwestern University for general training alone. In recognition of that fact, he will be given the degree of Bachelor of Science by the College of Liberal Arts. During the fifth year the general training of the student is continued and he completes his professional course in engineering.

The motto of the College is "Culture for Usefulness." This motto calls for an effort to obtain for the student the broadest culture attainable in five years in order to equip him, as a man and as an engineer, for the greatest possible usefulness in the world in the united struggle of man for progress.

Requirements for Admission

Candidates for admission without entrance conditions must qualify by examination or by certificate on fifteen units of High School work. The unit is a course of study requiring a daily recitation on a prepared topic for a full school year, and covering in the various subjects the work defined in the University Catalog.

English, three units; Algebra, one and a half units; and Plane Geometry, one unit, are required of all candidates. A choice is allowed in the selection of other subjects, but the choice must include either four units of foreign language or two units of foreign language plus two units chosen from the following group: College Algebra one-half unit, Plane Trigonometry one-half unit, Solid Geometry one-half unit, Physics one unit, Chemistry one unit, Manual Training one or two units, and Mechanical Drawing one or two units. The choice of foreign language is limited to Latin, Greek, French and German and a certain maximum number of units in each as indicated in the table which follows. A single unit of any language will be accepted only when accompanied by at least three units of some other language or two units each of two others. The remaining five and one-half units required to make an aggregate of fifteen units may include any subjects commonly appearing as a part of a high school course, provided that no subject is presented for less than a half unit of credit. Vocal music and physical training are not recognized for credit.

The following table indicates the subjects commonly presented for admission credit.

Latin	2, 3 or 4	units
Greek	2 or 3	units
German	2 or 3	units
French	2 or 3	units
Spanish	2	units
College Algebra	½	unit
Plane Trigonometry	½	unit
Solid Geometry	½	unit
Physiography	1	unit
Physics	1	unit
Botany	1	unit
Zoology	1	unit
Chemistry	1	unit
Ancient History	1	unit
Mediæval and Modern History	1	unit
English History	1	unit
American History (or with Civil Government)	1	unit
Civil Government	½	unit
Political Economy	½	unit
Commercial Geography	½	unit
Commercial Law	½	unit
Physiology	½	unit
Mechanical Drawing	1 or 2	units
Manual Training	1 or 2	units

One unit of entrance credit in Mechanical Drawing may be given for twelve hours work per week for a full school year, or an equivalent amount of time, provided the work is of an acceptable character. A second unit of credit may be given in Mechanical Drawing only in case the course in drawing taken in school covers the full equivalent of the course Engineering A1 of the College of Engineering.

One unit of entrance credit in Manual Training may be given for twelve hours work per week for a full school year, or an equivalent amount of time, provided the work is of an acceptable character. A second unit of credit may be given in Manual Training only in case the course in Manual Training taken in school covers the full equivalent of the course Engineering A2 of the College of Engineering.

For a statement in detail of the definitions of other entrance units consult the Catalog of the University.

Each student in engineering who has not presented Solid Geometry for entrance will be required to take Solid Geometry, three hours for one semester, in the first year. As this will be an extra task,

making it difficult for the student to keep up with his class, each candidate is advised to present this subject for entrance if possible.

So, too, there are various other ways in which a student in meeting the entrance requirements may by his selection of the subjects presented either lighten his later college work, or may so handicap himself as to make it difficult to secure an engineering degree in five years. For a general suggestion on this point, consult page 12.

A candidate may be admitted to the College of Engineering as a regular student with not more than two units of condition, but entrance conditions, if any, must be made up during the first year of residence.

Admission to the College of Engineering may be by certificate or by examination. Candidates for admission must be at least sixteen years of age. Graduates of accredited academies or high schools should obtain certificates of work done, showing the ground covered and the grade received in each study. These certificates should be sent to the Registrar, College of Engineering, at least one week before the opening of the fall semester. It is advisable to send them in much earlier. Certificate blanks may be had on request. Candidates who cannot present such certificates may be admitted on examination. Examinations for this purpose will be held September 20, 1915. The Board of Examiners will accept, in lieu of its examinations, those conducted by the College Entrance Examination Board. This Board holds examinations in June in the Northwestern University Building in Chicago, and at various other places in the United States.

ADVANCED STANDING

Students from other colleges seeking admission to this college must present evidence of honorable dismissal from the institution last attended and must present certificates showing (1) a full record of the applicant's preparation for college, (2) his college record, subject by subject, with the grade obtained in each subject and the year of the course in which it was taken. He should submit a catalog of his college, bearing his name, and of the issue current at the time of his admission to that college. Students from other colleges must first meet the entrance requirements to this college, after which the amount of advanced credit to be obtained by certificate will be estimated by a committee of the Faculty, but not finally placed to his credit until the student has been in residence in this college for one semester. Advanced credit without examination will be given only for work done in an approved college. Claims for advanced credit must be made during the first year of residence and not later than September of the collegiate year in which the candidate expects to graduate.

College credit for work done in a secondary school in excess of the requirements for admission can be given only on examination provided through the Registrar's office, and on the basis of five semester hours of credit for one unit of work. An exception to the examination rule is made in foreign language subjects continued in college during the first year, where the subsequent work is a sufficient test of the quality of the earlier work. Applications for such credit and for examination must be made to the Registrar during the first semester of residence and the examination must be taken at one of the regular dates set, viz.: the Wednesday of the opening week in September, or the Saturday following regular examinations in February. Advanced credit can be allowed only in Mathematics, foreign languages, or such other subjects taken in the last year of the secondary school course as may be approved by the Committee on Advanced Standing. No examination for advanced credit will be allowed after the first year of residence nor in subjects foreign to the college curriculum.

Courses of Study

The College of Engineering offers two course of study, each five years in length, one in Mechanical and Electrical Engineering and the other in Civil Engineering. These courses are alike in character and the same in content to the end of the third year.

For the satisfactory completion of the first four years of either course, the degree, Bachelor of Science, will be given by the College of Liberal Arts.

The degree, Electrical Engineer, will be given by the College of Engineering at the end of the five-year course in Mechanical and Electrical Engineering, and the degree, Civil Engineer, at the end of the five-year course in Civil Engineering.

COURSE IN MECHANICAL AND ELECTRICAL ENGINEERING

	Semester Hours	
Freshman Year	First Semester	Second Semester
English A1	3	3
French A	3	3
Physics A	4	4
Mathematics A3	5	5
Mechanical Drawing, Engineering A1, or Shop Work, Engineering A2	2	..
Mechanical Drawing, Engineering A1, or Shop Work, Engineering A2	..	2
Summer Work	..	2
Sophomore Year		
German A	3	3
Physics B1	3	3
Calculus, Mathematics B1	3	3
Chemistry A	4	4
Surveying, Engineering B2	3	3

	Semester Hours	
	First Semester	Second Semester
Shop Work, Engineering B1	1	1
Summer Surveying, Engineering B3	..	6
Junior Year		
Economics A	3	3
Physics C1	3	3
Chemistry B1	4	..
Chemistry B2	..	4
Geology A1	4	4
Descriptive Geometry, Kinematics, and Graphical Statics, Engineering C1	3	3
Summer Work	..	2
Senior Year		
English B	2	2
Structural Mechanics, Engineering D3	3	3
Calculus, Mathematics C1	3	3
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Electrical Engineering, Engineering D6	3	3
Elective	3	3
Summer Work	..	2
Fifth Year		
Hydraulic Engineering, Engineering E4	3	3
Thermodynamics, Engineering E1	4	..
The Public Relations of Engineers, Engineering E2	..	2
Thesis, Engineering E7	2	4
Engines, Engineering E3	3	3
Advanced Electrical Engineering, Engineering E5	3	..
Electric Power Plant Engineering, Engineering E6	..	3
Elective	2	2

COURSE IN CIVIL ENGINEERING

The first three years of this course are the same as those in the course in Mechanical and Electrical Engineering shown above.

	Semester Hours First Semester	Semester Hours Second Semester
Senior Year		
English B	2	2
Structural Mechanics, Engineering D3	3	3
Calculus, Mathematics C1	3	3
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Electrical Machinery, Engineering D5	3	..
Heat Engines, Engineering D4	..	3
Elective in Geology	3	3
Summer Work	..	2
Fifth Year		
Hydraulic Engineering, Engineering E4	3	3
Railroad Engineering, Engineering E10	4	..
The Public Relations of Engineers, Engineering E2	..	2
Thesis, Engineering E7	2	4
Structures, Engineering E9	5	..
Bridges, Engineering E8	..	5
Elective	3	3

Each course contains seventeen semester hours of credit each semester, exclusive of summer work.

Each course may be taken precisely as shown above by a student who enters the College with the standard preparation which includes English three units, Algebra one and one-half units, Plane Geometry one unit, Solid Geometry one-half unit, French two units, and German two units. If however the student enters College deficient in any of the subjects enumerated in the preceding sentence and the deficiency is not counterbalanced by excess elsewhere in his preparation of the character indicated later in this paragraph, it will be impossible for him to complete either engineering course in five years without securing more than an average of seventeen semester hours of credit in each semester. Only an exceptionally strong student may expect to secure more than seventeen hours of credit per semester. Certain subjects when accepted for entrance credit constitute an excess in the sense that they relieve the student offering them of some college work which would otherwise be required of him in the engineering courses. These are College Algebra, Plane Trigonometry, Chemistry (if accepted by the department of Chemistry as warranting the student's admission directly to the college course Chemistry AB instead of to Chemistry A), a second unit of Mechanical Drawing, a second unit of Manual Training, and such preparation in foreign language as will leave the student less than twelve semester hours of foreign language to be taken in college in order to meet the requirements for the degree of Bachelor of Science which are shown in the Catalog of the University. As an example it may be stated that a student who presents three units of German or Latin, and two of French, is required to take in college French A only, six semester hours, instead of both French A and German A as listed above, twelve semester hours.

For recitations or lectures one semester hour of credit is given for one period, fifty minutes, each week, during one semester. For shop work, drafting or laboratory work, one semester hour of credit is given for one three-hour period each week during one semester.

During each of the three summers following the first, third and fourth years the student is required to do practical work for at least six weeks, of such a character as to furnish experience of value to him as a prospective engineer. The credit assigned to six weeks of such approved work is two semester hours.

Under this requirement, students have acted as rodmen on city surveys, rodmen on the United States Lake Survey, workers in the tool room of a factory, helpers in the installation of heavy machinery in a new steam-electric power plant, foreman of a gang of laborers, helpers in the wiring of telephone switchboard, assistants in cement testing, computers for the Carnegie Institution, inspectors with a company engaged in electric lighting and power distribution, and have worked on milling and machine work, figuring estimates, making tracings, and on land and topographical surveys.

During the summer following the second year the student is required to do field work in surveying for six weeks immediately following commencement, Engineering B3, credit six semester hours. This is a regular college course under the direction of college professors, taken at a summer camp established for that purpose.

DESCRIPTION OF COURSES

The following paragraphs give more specific information in regard to the separate courses enumerated above as together constituting the courses in Mechanical and Electrical Engineering and in Civil Engineering.

English A1. Composition and Rhetoric; Brief Survey of English Literature. Required of all students in their first year. Three semester hours throughout the year.

English A2. Composition and Rhetoric. Required of students whose preparation is found to be insufficient for English A1. The work of the first semester is continued two hours a week in the second semester and attendance is required until the student's work is brought consistently up to a satisfactory standard.

French A. Modern French. Koren's Composition. Buffum's French Short Stories. Advanced Grammar. Reading. Copee's On rend l'Argent. Pailleron's Le Monde ou l'on s'Ennuie. Victor Hugo's Quatre-Vingt Trieze. Canfield's French Lyrics. Coppee's Le Pater. Victor Hugo's Hernani. Private reading: Cameron's Selections from Loti. Three semester hours throughout the year. Open to students who present two units of French for entrance. If the student has presented no French for entrance he must take French AA, five semester hours throughout one year, in college before being admitted to French A, or if he has presented one unit of French for entrance, he must ordinarily take French AB, three semester hours throughout one year, in college before being admitted to French A.

German A. Intermediate German—Some sections take modern prose writers, Storm, Freytag, Seidel, Hoffmann, Ernst, etc. German lyrics and ballads. Other sections take Lessing's Minna von Barnhelm, German lyrics and ballads, Schiller's Wilhelm Tell and Maria Stuart, Lessing's Nathan der Weisse. Three semester hours throughout the year. Open to students who present two units of German for entrance. If the student has presented no German for entrance he must take German AA, five semester hours throughout one year, in college before being admitted to German A, or if he has presented one unit of German for entrance he must ordinarily take German AB, three semester hours throughout one year, in college before being admitted to German A.

If the student has offered for entrance two units of French and two of German, he is advised to take French A in the first year and German A in the second year, but the order may be reversed. If other language units than those named in the preceding sentence have been offered for entrance, the student is required to take such language courses as will satisfy the language requirement for the degree of Bachelor of Science. These are not necessarily the courses French A and German A. For example, if a student has presented two or three units of Latin or of Greek for entrance he may be released, both as to entrance credits and as to college work, from a part of French or German. For complete information on this point, consult the statement of prescribed courses for the degree of Bachelor of Science, in the University catalog.

Mathematics A3. Plane Trigonometry, Algebra and Analytical Geometry—This is a course in which Plane Trigonometry, Algebra and Analytical Geometry are given together in one continuous course. Open to students who have presented one and a half units of Algebra for admission. Five semester hours throughout the year.

If a student has presented College Algebra or Plane Trigonometry for entrance, instead of taking Mathematics A3 in the freshman year, he is required to take three semester hours in each of two semesters in courses so arranged that with the work offered for entrance they will be equivalent to Mathematics A3.

Mathematics B1. Differential and Integral Calculus. A first course in Calculus, including its simpler applications. Open to students who have completed Mathematics A3, or an equivalent. Three semester hours throughout the year.

Mathematics C1. Advanced Calculus—Infinite series; Taylor's theorem; partial differentiation; differential geometry; definite integrals over curves, surfaces and volumes; the Eulerian functions; Fourier's series; differential equations. Open to students who have completed Mathematics B1. Three semester hours throughout the year.

Physics A. General Physics—First semester—General properties of matter, wave-motion, sound. Second semester—Heat, electricity, magnetism, light. An introductory course requiring no mathematics beyond the requirements for entrance to college, intended to acquaint the student with the elementary facts, the method, and the general principles of physical science. Text-book: Crew's General Physics. Three lectures and one laboratory exercise each week. Open to all students. Four semester hours throughout the year.

Physics B1. Mechanics—An elementary experimental study of forces, moments of force, moments of inertia, elasticity, hydromechanics, an introduction to advanced Physics and Engineering. This is a course in pure Dynamics, and serves as an introduction to Applied Mechanics. Text-book: Crew's Principles of Mechanics. Two lectures and one laboratory exercise each week. The laboratory work is guided by especially prepared instructions. Open to students who have completed Physics A, or its equivalent, and who have completed or are taking Mathematics B1. Three semester hours throughout the year.

Physics C1. Electricity and Magnetism—The more general laws of electricity and magnetism are discussed; the practical equations employed in the laboratory are derived and discussed. Text-book: Starling's Electricity and Magnetism. The laboratory work includes the measurement by one or more methods of current, resistance, electromotive force, temperature-coefficients, capacity; a study of the magnetic properties of iron and steel, thermoelectric effects, the use of the electrometer, the Carey Foster bridge, potentiometer, copper voltameter, etc. Open to students who have completed Mathematics B1 and who have completed or are taking Physics B1. Two lectures and one laboratory exercise each week. Three semester hours throughout the year.

Chemistry A. A General Chemistry, Elementary—Text and laboratory work. Open to all students. Four semester hours throughout the year.

Chemistry AB. General Chemistry—To supplement the high school course, making the total equivalent to Chemistry A. Open to students who present one unit of chemistry for entrance, provided that unit is accepted by the department of Chemistry as warranting admission to Chemistry AB. Four semester hours in the first semester only.

Chemistry B1. Qualitative Analysis—Analysis of simple mixtures accompanied by lectures and quizzes. Recitations and laboratory work. Open to students who have completed Chemistry A or an equivalent. Four semester hours for one semester, to be taken in either semester.

Chemistry B2. Organic Chemistry—Lectures and quizzes on the hydrocarbons and their derivatives. Laboratory preparation and study of typical organic compounds. Recitations and laboratory work. Open to students who have completed Chemistry A and B1 or an equivalent. Four semester hours for one semester, to be taken in either semester.

Geology A1. General Geology—A general introduction to Geology. Lectures, recitations and laboratory work. Open to students who have completed in college or in high school a year-course in Chemistry. Four semester hours throughout the year.

Geology B5. Metallurgy—Fuels, refractory and cementing materials, metallurgy of iron and steel. Open to those students of Engineering who have completed Chemistry A. Two semester hours in the first semester only.

Economics A. The Elements of Economics—An elementary course in the principles of economics. First semester. An examination of the fundamental principles of economics. Second semester. Application of these principles to practical problems. Throughout the course special attention is given to the relation between theory and practice. Open to sophomores. Three semester hours throughout the year.

English B. English Literature; Composition—Lectures, recitations, written reports and themes, and reading. Open to students who have completed the required English of the first year. Two semester hours throughout the year.

Electives—Six semester hours of electives are provided for in the senior year of the Mechanical and Electrical Engineering course and four in the fifth year. In the fifth year of the Civil Engineering course six hours of electives are required. These electives are limited to courses given in the College of Liberal Arts, the choice to be approved by the Director.

Elective in Geology—Six hours of elective work limited to the courses in Geology given in the College of Liberal Arts, are required in the senior year of the Civil Engineering course.

Engineering A1. Mechanical Drawing—An elementary course in the technique of mechanical drawing, requiring no previous knowledge of drawing. Freehand lettering, exercise drawing, freehand sketching, shop drawing in pencil, tracing in ink on tracing cloth. Open to all students. Two drawing periods each week. Two semester hours for one semester, to be taken in either semester.

Engineering A2. Freshman Shop Work—A series of elementary practical exercises in the shop, upon a wide variety of subjects, the object being to bring out the principles involved, to acquaint the student with a considerable range of mechanical experience, and to cultivate habits both of logical thinking and of accurate work. The exercises involve some wood turning, pattern making, filing, scraping, sawing, punching, riveting, brazing, metal turning, shaping, planing, milling, grinding, etc. These exercises are guided by assigned readings, blue-printed instructions and by lectures on mechanical princi-

ples and processes, with occasional written work. Open to all students. Two shop periods each week. Two semester hours for one semester, to be taken in either semester.

Ordinarily it is expected that an engineering student will take Engineering A1 in one semester and Engineering A2 in the other semester of his freshman year.

Engineering B1. Sophomore Shop Work—This is a more intensive course than Engineering A2, limited mainly to pattern work, machine work, and tool making. The work is upon problems rather than exercises, and in them the student is given an opportunity to show his ingenuity and his grasp of the subject; while his work is directed in a general way, he is not given detailed instructions. The objects made are generally parts of some machine; this emphasizes the need for accuracy and gives a practical turn and interest to the subject. The work naturally introduces the student to a somewhat advanced knowledge of machines and processes. Open to students who have completed Engineering A2. One shop period each week. One semester hour throughout the year.

Engineering B2. Surveying—The use of chains, tapes, compass, level, transit, and plane table; methods of land, topographic and hydrographic surveying, including stream measurement, mine surveying and city surveying. Text-book: Theory and Practice of Surveying, by J. B. Johnson and L. S. Smith. Open to students who have completed Engineering A1 and Mathematics A3. Two recitations and one field period each week. Three semester hours throughout the year.

Engineering B3. Summer Surveying—Applications under actual field conditions of the theory taught in Engineering B2. The outcome of the work will be a map of the region covered by the survey and much allied information. A new area will be covered each year, ordinarily adjacent to the area surveyed in the preceding year. The survey camp in 1913 was established in the Fox Lake region in Illinois, near Antioch. Six weeks immediately following commencement. Open to students who have completed Engineering B2. Credit six semester hours.

Engineering C1. Descriptive Geometry, Kinematics and Graphical Statics—The course is divided into three equal parts. (1) Descriptive Geometry; first principles; point, line and plane; curved lines and surfaces; plain sections and developments; intersections of surfaces. Text-book: Essentials of Descriptive Geometry by Phillips and Millar. (2) Kinematics; elementary propositions; communication of motion by rolling and sliding contact, by link work, by wrapping connectors; trains of mechanism; aggregate combinations. Text-book: Elementary Mechanism by Stahl and Woods. (3) Graphical Statics; general principles; concurrent and non-concurrent forces; moments; center of gravity of areas; moment of inertia; roof trusses; loads; reactions; stresses; wind load stresses; cantilever and unsymmetrical trusses; counter-bracing; three-hinged arch; transverse bent. Text: Graphic Statics, by Malcolm. Open to students who have completed Engineering A1 and Mathematics A3. One recitation period and two drawing periods each week. Three semester hours throughout the year.

Engineering D1. Contracts and Specifications—The course deals with contracts and specifications as applied to engineering only. Recitations and lectures. Text-book: The Law of Contracts by John C. Wait. Open to students who have sixty hours of credit. Two semester hours in the second semester only.

Engineering D2. Journal Meeting—The time is spent in reading and reviewing current engineering literature, the object being to acquaint the student with this fund of information, to show him the necessity of judicious selection from the great mass of such current literature, to indicate methods of selection, and to cultivate a habit of accurate reading. Open to students who have taken or who are taking Engineering D3, D4, D5, or D6. One laboratory period each week. One semester hour throughout the year.

Engineering D3. Structural Mechanics—The text-book work is upon the application of mechanics to the elementary parts of structures, taking up properties of materials, testing materials, elementary theory of elasticity, stresses and strains of beams, columns, shafts, tubes, curved bars, springs and bodies in rapid rotation; stability of piles and retaining walls; elementary theory of reinforced concrete. The laboratory work relates partly to standard methods of testing materials such as steel and cement, but it is largely involved in an effort to bring to the clear comprehension of the student the various relations deduced in the text-book work upon the subject. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering D4. Heat Engines—A course in prime movers and general power plant equipment. Elementary thermodynamics. Construction and operation of steam engines, turbines and gas engines. Engine testing. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours in the second semester only.

Engineering D5. Electrical Machinery—A course in Direct and Alternating Current Machines. Special emphasis is placed upon the study of the fundamental principles involved and upon the application of these principles in practise. Electrical testing. Open to students who have completed Mathematics B1 and Physics C1. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering D6. Electrical Engineering—First semester—A general study of the fundamental principles of Electrical Engineering and their applications to direct current machinery. A selected series of problems are assigned to illustrate quantitatively the principles involved. Second semester—A general study of the fundamental principles of single and polyphase alternating currents, with special reference to analytic, graphic and symbolic methods of treatment. Elementary analysis of alternating current machinery. Open to students who have completed Physics C1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E1. Thermodynamics — The course consists of text-book work first upon the general theory of thermodynamics, and later upon its application to heat engines, taking up properties of gases, flow of gases, thermodynamics of air engines, internal combustion engines and air compressors, properties of steam and other vapors, thermodynamics of steam engines and steam turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Four semester hours in the first semester only.

Engineering E2. The Public Relations of Engineers—A course of lectures and reading dealing with the relations of a practising engineer to other men. It will deal in part with biographies of engineers, the history of engineering, the purpose of organization and the conservation of natural resources. Open to students who have taken or who are taking Engineering E1, E3, E4, E5, E6, E8 or E9. Two semester hours in the second semester only.

Engineering E3. Engines—A detailed study of the steam engine, steam turbine, boiler plant equipment, gas engines and producer gas plants. Open to students who have taken or who are taking Engineering E1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E4. Hydraulic Engineering—The theory and application of the principles of hydrostatics and hydrodynamics; measurements of flow by pressure gauges, meters, Pitot tubes and weirs; path, energy and impulse of jets; flow through orifices, tubes and pipes with loss of energy or head due to contractions, expansions and nozzles; derivation and application of formulæ for discharge, velocity and pressure; work derived from moving vanes as in water wheels and turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E5. Advanced Electrical Engineering—Advanced analysis by the analytic, symbolic and graphic methods of treatment of alternating current machinery, of general alternating current and of transient phenomena. Lectures, assigned reading, recitations and laboratory work. Open to students who have completed Engineering D6. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering E6. Electric Power Plant Engineering—A study of special problems in connection with the generation and transmission of electrical energy in large systems and in high potential systems. Emphasis is laid upon the proper relation of parts to form a complete plant. Lectures, assigned reading, recitations and laboratory work. Open to students who have completed Engineering E5. Two recitations and one laboratory period each week. Three semester hours in the second semester only.

Engineering E7. Thesis—Open to students in the last year in the Engineering course. Two semester hours in the first and four in the second semester.

Engineering E8. Bridges—A general course on the theory and design of bridges, taking up stone arches, reinforced concrete arches, culverts and steel bridges of many types. Open to students who have completed Engineering D3. Three recitations and two drawing periods each week. Five semester hours in the second semester only.

Engineering E9. Structures—A general course on the theory and design of foundations, retaining walls, tall chimneys, masonry dams and building construction. Open to students who have completed Engineering D3. Three recitations and two drawing periods each week. Five semester hours in the first semester only.

Engineering E10. Railroad Engineering—The use of the transit, chain, level, etc., in laying out simple, compound and vertical curves; methods of reconnaissance, preliminary and location surveys; turnouts, switches and wye tracks; profile and cross section surveys, and computation of earthwork; haul and mass diagrams; maps and drawings; the use of topographic surveys in location; drainage, waterways and bridge staking. Economic theory of railway location, construction, extension and maintenance. Field work consists of laying out a short line and of the practical application of methods of staking, computation and mapping given above. Open to students who have completed Engineering B2 and Mathematics B1. Three recitations and one field period each week. Four semester hours in the first semester only.

General Regulations

REGISTRATION

Every student is required to register in person at the office of the Registrar, College of Engineering, before entering upon college work, on the registration days specified in the calendar. Returning students who register after the close of this period are subject to a fee of two dollars.

On the registration days of the first semester the student must register for the work of the whole year. Changes may be made only with the consent of the Director. A course dropped without consent is regarded as a failure and is so recorded.

At the time of registration the student obtains from the Registrar his tuition bill for the semester. This must be presented immediately at the Business Manager's Office for payment.

CLASSIFICATION

Students in the College of Engineering are grouped in five classes according to their credits in the office of the Registrar. The basis for their classification is as follows:

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first four years, and who have satisfied all entrance requirements, are classed as fifth year students.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first three years, and who have satisfied all entrance requirements, are classed as seniors.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first two years, and who have satisfied all entrance requirements, are classed as juniors.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first year, and who have satisfied all entrance requirements, are classed as sophomores.

All other regular students are classed as freshmen, without regard to the date of admission.

GRADES OF SCHOLARSHIP, EXAMINATIONS, AND ATTENDANCE

In other matters of student regulation, such as examinations, grades of scholarship, class and chapel attendance, and physical training, the students of the College of Engineering are governed by the regulations stated in the general University Catalog and in the Undergraduate's Manual.

FEES AND EXPENSES

Registration Fee, paid by every student at the beginning of each semester	$ 5.00
Tuition and Incidentals, per year, except for Fifth Year students	110.00
Tuition and Incidentals, per year, for Fifth Year students	40.00

Tuition and Incidentals are payable one-half at the beginning of the first semester, one-half at the beginning of the second.

Laboratory Fees.

Chemistry A	$7.50 a semester
Chemistry B1 or B2	9.00 a semester
Geology A1	2.00 a semester
Physics A or B1	2.00 a semester
Physics C1	3.00 a semester
Engineering A1	6.00 a semester
Engineering A2	8.00 a semester
Engineering B1	4.00 a semester
Engineering B2 or D3	5.00 a semester
Engineering C1, D4, D5, D6, E3, E4, E5, E6, E8, E9 or E10	3.00 a semester
Student Enterprise Fee	2.50 a semester
Fee for summer surveying course, Engineering B3	15.00
Diploma Fee	10.00

The laboratory fees for engineering courses are intended to cover ordinary depreciation of apparatus and the use of materials. The student is held responsible for any damage due to his negligence.

Laboratory fees are not refunded if the student continues in a course as long as two weeks, except that in the Chemical Laboratory the fee is in the nature of a deposit, and an account is kept of the material used, the unexpended balance at the end of the year being returned to the student.

The tuition fees will not be refunded except in case of sickness. If a student withdraws before the middle of the semester, on account of serious illness, one-half of his tuition fee will be refunded, on his obtaining from the Director a statement of honorable standing, and from a physician a certificate that his health will not permit him to remain in attendance.

Reduced rates of tuition are given to sons of clergymen who are actively pursuing the work of the ministry ($33.00 per semester) and to holders of old-time perpetual or transferable scholarships, for incidentals ($32.50 per semester).

The remaining necessary expenses of a student, namely, board, room, laundry, text-books and stationery, for nine months, vary from $260 to $480, the average being about $340.

Students find comfortable homes in private families or live in club houses under their own management. Clubs are formed in which the cost of table board is reduced to a minimum.

DORMITORIES

A new system of eleven dormitories for men students was put into use in 1913-1914. Seven of these buildings are designed for fraternities, whose alumni have contributed toward their cost, and the remaining four are open for rental by any of the men students of the University.

The buildings are architecturally beautiful and are meant to be models in comfort and sanitation. They are fireproof, lighted by electricity, and heated by steam. On the first floor of each building is a large enclosed porch, and a well equipped club room with an open

fire-place, rugs, tables, and lounging chairs. There are also a few rooms for individual students on this floor. The second and third floors are made up entirely of single rooms.

Each student's private room is furnished with a single bed, mattress and pillow, a chiffonier, a combined study table and bookcase, two chairs, a rug, and window shades. The student furnishes his own bedding and towels, but the University takes charge of the laundering of these. In the interest of economy, electric lighting is not included in the general charge, but is apportioned pro rata monthly to the occupants of the building.

In the men's dormitories room rent is payable at the beginning of each semester and the charge to each student for the use of a furnished single room, including care, heat and water, is one hundred dollars a year. The rental for private rooms on the first floor is somewhat higher.

The Registrar of the College of Liberal Arts is the renting officer of the dormitories; and men of the College of Engineering not living at their homes or in fraternity houses are required to live in the dormitories unless no rooms are available, or they obtain through the Registrar written permission to room elsewhere. Blank application forms for such permission will be furnished on request.

A chart showing the location and rental prices of rooms may be had from the Registrar upon application.

SCHOLARSHIPS

A few scholarships, which cover tuition, are awarded annually (five in 1914-1915) to select members of the incoming class, upon applications endorsed by the principal and faculty of the secondary school from which the applicant graduates. The applicant must meet the full entrance requirements and must present certificates from the teachers in his secondary school for excellence of character and scholarship, for physical vigor, manliness and promise of usefulness as a citizen. The award is made at the University by a committee of the College faculty.

A few scholarships, which cover tuition, are awarded annually (four in 1914-1915) to select members of the upper classes.

The upper class scholarship known as the *Swift Scholarship* has been given by Mrs. Gustavus F. Swift to members of the upper classes.

OPPORTUNITIES FOR SELF HELP

Some students in Evanston have been able, while in college, to earn the cost of their living in full, and every year a large percentage earn a considerable portion of their expenses, and at the same time maintain a high standing in their studies. It is never advisable, however, for a student to undertake more work of this kind than is necessary for his personal support, and if the amount is excessive he should plan to give more than the normal five years to his college course.

The General Secretary of the Young Men's Christian Association maintains a bureau to assist students in finding employment. The positions most frequently open to young men are those as waiters at boarding places or as attendants in private houses in the care of gardens or furnaces. While the aggregate of the annual earnings of students is a large sum, the number of positions open is limited and no assurances can be given that employment will be found. Only the most faithful and self-reliant students should undertake self-support, and in no case should a student come to Evanston without sufficient means to meet expenses for at least a half-year.

RELIGIOUS AND SOCIAL LIFE OF STUDENTS

The charter of the University provides that "no particular religious faith shall be required of those who become students of this institution." Students are expected to attend public worship on Sunday in the church of their choice. Chapel service is held at ten o'clock on each week day, except Friday and Saturday, throughout the college year. Attendance upon at least one-half of these services is required. Under the direction of the Young Men's Christian Association religious meetings are held each week.

In athletics, in social life and in the use of the buildings, there is no separation of the students of Engineering from the students of Liberal Arts. Engineering students go to the various buildings of the College of Liberal Arts for recitations in other than strictly engineering subjects. They share in the use of the University Library. They have free access to the new gymnasium, the largest in the United States. Their social life is mingled with that of the Liberal Arts students in one university group.

The Engineering Society, composed of students of engineering and members of the engineering faculty, provides numerous addresses by prominent engineers and organizes inspection trips to points of engineering interest. The members also furnish many additional programs so that the society holds a meeting nearly every week.

Some Advantages of the College of Engineering at Northwestern University

It offers a thorough professional course rather than a purely practical course. It places the emphasis on the fundamentals which are common to all branches of engineering. It trains its graduates for unlimited growth as engineers and for possible leadership.

The engineering courses, five years in length, are so arranged as to give each man his general broad training at the same time that he pursues his engineering studies. The engineering students are closely associated with the larger group of Liberal Arts students, of which they, in fact, form a part.

In the purely engineering part of the course, the proportion of professors to students is much larger than is customary and each student, therefore, receives an unusual amount of attention.

There is more engineering in progress within fifty miles of the loop district of Chicago than in any area of the same size anywhere in the United States with the possible exception of New York City. The students of this College thus have an unsurpassed opportunity to keep in touch with engineering practise and to meet engineers.

The College of Engineering is a new organization not hampered by traditions, and is thus in an excellent condition to take advantage of the experience of other colleges in training engineers.

It is provided with ample shop and laboratory equipment, selected with unusual care and deliberation, purely for teaching purposes and housed in an excellent building.

Inquiries for further information, requests for the catalog of the University, for scholarship application blanks, and for blank forms of certificates from secondary schools may be addressed to John F. Hayford, Director, College of Engineering, Northwestern University, Evanston, Illinois.

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Northwestern University

¶ THE COLLEGE OF LIBERAL ARTS, located at Evanston, in an ideal college community, offers special preparation for the professions and for pursuits requiring broad training.

¶ THE MEDICAL SCHOOL is one of the oldest, largest, and best equipped. Seven hospitals are open to students. Clinic material is abundant.

¶ THE LAW SCHOOL, the oldest law school in Chicago, offers unexcelled library facilities and special courses that prepare for immediate practise in any state upon graduation.

¶ THE COLLEGE OF ENGINEERING has its own building completed in 1909, beautifully situated, a model of efficiency. Technical studies in a University environment.

¶ THE SCHOOL OF PHARMACY offers a scientific training in Pharmacy, Chemistry and Drug and Food Analysis. Special courses for Drug Clerks.

¶ THE DENTAL SCHOOL offers expert training in theory and practise. Facilities are unsurpased. Its clinic is the largest in the world.

¶ THE SCHOOL OF MUSIC affords a scientific preparation for music as an accomplishment and a profession. It is located at Evanston.

¶ THE SCHOOL OF COMMERCE provides instruction in economics, elementary and corporation finance, commercial law and accounting. Many lecturers from business and professional life.

¶ THE SCHOOL OF ORATORY has its own building and a faculty with long and successful experience.

¶ EVANSTON ACADEMY prepares for college, for engineering, for professional schools and for business.

For information regarding any school of the University, address President A. W. Harris, Northwestern University Building, Chicago.

NORTHWESTERN UNIVERSITY BULLETIN is published by Northwestern University weekly during the academic year at Chicago, Ill. Entered as second-class mail matter November 21, 1913, at the post office at Chicago, Ill., under act of Congress of August 24, 1912.

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Northwestern University Bulletin

COLLEGE *of* ENGINEERING ANNOUNCEMENTS
1916 - 1917

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Published Weekly by Northwestern University
Northwestern University Building
CHICAGO

Vol. XVI, No. 31 April 21, 1916

NORTHWESTERN UNIVERSITY

Special Advantages of the New College of Engineering

A thorough professional course rather than a purely practical one, with five years of broad training.

Small classes in which each student receives an unusual amount of individual attention.

A splendid building designed for the purpose, with entirely new apparatus.

Accessibility to great engineering projects, with unsurpassed opportunities to meet engineers and keep in touch with engineering practice.

A young thriving college in an old university.

Northwestern University Bulletin

COLLEGE *of* ENGINEERING ANNOUNCEMENTS
1916-1917

Published by the University
April, 1916

SWIFT HALL OF ENGINEERING

Swift Hall of Engineering, the gift of Mrs. Gustavus F. Swift and her son, Edward F. Swift, was dedicated in 1909. The building measures fifty-eight by one hundred and twenty-six feet; the exterior is of Bedford limestone, and presents architectural lines that are of the best; the interior is a model of appropriate decoration, convenience, safety and strength; it has concrete floors and stairways throughout. It presents five working stories, all well lighted and of good height, while the large rooms at the ends of the building are free from columns. From the beginning, it was especially planned as the home of the College of Engineering. The building is in a delightful location overlooking Lake Michigan.

Faculty

ABRAM WINEGARDNER HARRIS, Sc.D., LL.D.
President

JOHN FILLMORE HAYFORD, C.E.
Director

OLIN HANSON BASQUIN, Ph.D.
Professor of Applied Mechanics

WILLIAM CHARLES BAUER, B.S., Sc.D.
Professor of Electrical Engineering

HERBERT SHAW PHILBRICK, B.A., B.S.
Professor of Mechanical Engineering

WILLIAM HENRY BURGER, B.S.
Professor of Civil Engineering

MILBY ROY HAMMER, B.S.
Associate Professor of Drawing

JAMES TAFT HATFIELD, Ph.D.
Professor of German Language and Literature

HENRY CREW, Ph.D.
Professor of Physics

EDOUARD PAUL BAILLOT, L.H.D.
Professor of Romance Languages

ULYSSES SHERMAN GRANT, Ph.D.
Professor of Geology

ARTHUR CHARLES LEWIS BROWN, Ph.D.
Professor of English Literature

Willard Eugene Hotchkiss, Ph.D.
Professor of Economics

David Raymond Curtiss, Ph.D.
Professor of Mathematics

Walter Lichtenstein, Ph.D.
Librarian

William Frank Bryan, Ph.D.
Associate Professor of English

Murray Arnold Hines, Ph.D.
Assistant Professor of Chemistry

Elton James Moulton, Ph.D.
Assistant Professor of Mathematics

Keith Kuenzi Smith, Ph.D.
Assistant Professor of Physics

George Vest McCauley, Ph.D.
Instructor in Physics

Clarence Stephen Marsh, B.A.

Registrar

Dorothy Lewis Sage
Assistant Registrar

Andrews Allen, C.E.
Lecturer on Contracts and Specifications

Elmer Martin Liessmann, LL.B.
Lecturer on Contracts and Specifications

Ivan Herbert Spoor, B.S.
Shop Assistant

Calendar

1916-1917

1916	
Sept. 25, Mon.	Academic year 1916-1917 begins; examinations for admission; first day of registration
Sept. 27, Wed.	Second examinations
Sept. 28, Thurs.	Class work begins
Nov. 30, Thurs.	Thanksgiving Recess, to December 3, inclusive
Dec. 20, Wed.	Christmas Recess, to January 3, Wednesday, inclusive
1917	
Jan. 4, Thurs.	Class work resumed
Jan. 29, Mon.	Mid-year examinations begin
Feb. 10, Sat.	Second examinations; last day of registration for second semester
Feb. 12, Mon.	Second semester begins; class work resumed
Feb. 22, Thurs.	Washington's birthday
Apr. 6, Fri.	Easter Recess, to April 9, Monday, inclusive
Apr. 9, Mon.	Second examinations
May 28, Mon.	Regular examinations begin
May 30, Wed.	Memorial day
June 13, Wed.	FIFTY-NINTH ANNUAL COMMENCEMENT
June 14, Thurs.	Beginning of summer surveying
July 25, Wed.	End of summer surveying

Historical Note

THE charter of Northwestern University was signed by the Governor of Illinois on January 28, 1851. The corporation consists of forty-two trustees. An amendment to the charter provides that no intoxicating liquors shall be sold within four miles of the University.

The trustees selected as the seat of the University a tract of land on the shore of Lake Michigan, twelve miles north from the heart of Chicago. Here in 1855 the first University building was erected and about its location has grown up the City of Evanston. Here are the College of Liberal Arts, the College of Engineering, the School of Music, and the School of Oratory. The schools of Medicine, Law, Pharmacy, Dentistry and Commerce are located in the City of Chicago.

The College of Liberal Arts, the oldest department of the University, was opened to students in the fall of 1855. From its small beginning it has grown, not by rapid expansion or by large benefactions, but by steady gains along conservative lines—each of its sixty years adding some improvements to its physical and educational equipment. The work of the College of Liberal Arts is mainly directed toward furnishing opportunities for a liberal culture or general education. The regulations affecting the choice of studies are such that the student may elect a large part of his work along lines in which he is especially interested.

In recent years a demand for instruction in engineering gradually made itself felt. A gift for the erection of an engineering building at Evanston and for its endowment led the Trustees of the University to take action in June, 1907, resulting in the establishing of a College of Engineering. This gift came from Mrs. Gustavus F.

Swift and her son, Edward F. Swift. The building, known as the Swift Hall of Engineering, was dedicated in May, 1909. It is now occupied by the College of Engineering. The Department of Mathematics of the College of Liberal Arts also has offices and recitation rooms in the building.

In 1915-1916, the College of Engineering had a total registration of one hundred students.

STATEMENT OF PURPOSE

The purpose of the College of Engineering of Northwestern University is to furnish to each student a thorough training for the profession of engineering, combined with a general training of the man. The College aims to train engineers for the greatest average effectiveness in a lifetime rather than for the greatest effectiveness in the first year after graduation. It aims to develop a capacity for unlimited growth. Hence strong emphasis is laid on those studies which tend to develop the man as well as on those which furnish training in engineering.

In keeping with these ideals, the courses in engineering introduce an unusual number of those non-technical studies that serve to give a general education and to develop the thinking power of the students. Unusual stress is laid upon Mathematics, upon Physics and other sciences fundamental to engineering and upon the principles which are broadly applicable to all engineering. The courses are five years in length, because past experience among colleges of engineering shows that four years is too short a time for the thorough professional training contemplated. At the end of four years the student of engineering will have secured as thorough a general training as one who comes to Northwestern University for general training alone. In recognition of that fact, he will be given the degree of Bachelor of Science by the College of Liberal Arts. During the fifth year the general training of the student is continued and he completes his professional course in engineering.

The motto of the College is "Culture for Usefulness." This motto calls for an effort to obtain for the student the broadest

culture attainable in five years in order to equip him, as a man and as an engineer, for the greatest possible usefulness in the world in the united struggle of man for progress.

Requirements for Admission

Candidates for admission without entrance conditions must qualify by examination or by certificate on fifteen units of High School work. The unit is a course of study requiring a daily recitation on a prepared topic for a full school year, and covering in the various subjects the work defined in the University Catalog.

English, three units; Algebra, one and a half units; and Plane Geometry, one unit, are required of all candidates. A choice is allowed in the selection of other subjects, but the choice must include either four units of foreign language or two units of foreign language plus two units chosen from the following group: College Algebra one-half unit, Plane Trigonometry one-half unit, Solid Geometry one-half unit, Physics one unit, Chemistry one unit, Manual Training one or two units, and Mechanical Drawing one or two units. The choice of foreign language is limited to Latin, Greek, French and German and a certain maximum number of units in each as indicated in the table which follows. A single unit of any language will be accepted to meet the specific foreign language requirement only when accompanied by at least three units of some other language or two units each of two others. The remaining five and one-half units required to make an aggregate of fifteen units may include any subjects commonly appearing as a part of a high school course, provided that no subject is presented for less than a half unit of credit. Vocal music and physical training are not recognized for credit.

The following table indicates the subjects commonly presented for admission credit:

Latin	2, 3 or 4	units
Greek	2 or 3	units
German	2 or 3	units
French	2 or 3	units
Spanish	2	units
College Algebra	½	unit
Plane Trigonometry	½	unit
Solid Geometry	½	unit
Physiography	1	unit
Physics	1	unit
Botany	1	unit
Zoology	1	unit
Chemistry	1	unit
Ancient History	1	unit
Mediæval and Modern History	1	unit
English History	1	unit
American History (or with Civil Government)	1	unit
Civil Government	½	unit
Political Economy	½	unit
Commercial Geography	½	unit
Commercial Law	½	unit
Physiology	½	unit
Mechanical Drawing	1 or 2	units
Manual Training	1 or 2	units

One unit of entrance credit in Mechanical Drawing may be given for twelve hours work per week for a full school year, or an equivalent amount of time, provided the work is of an acceptable character. A second unit of credit may be given in Mechanical Drawing only in case the course in drawing taken in school covers the full equivalent of the course Engineering A1 of the College of Engineering.

One unit of entrance credit in Manual Training may be given for twelve hours work per week for a full school year, or an equivalent amount of time, provided the work is of an acceptable character. A second unit of credit may be given in Manual Training only in case the course in Manual Training taken in school covers the full equivalent of the course Engineering A2 of the College of Engineering.

For a statement in detail of the definitions of other entrance units consult the Catalog of the University.

Each student in engineering who has not presented Solid Geometry for entrance will be required to take Solid Geometry, three hours for one semester, in the first year. As this will be an extra task,

making it difficult for the student to keep up with his class, each candidate is advised to present this subject for entrance if possible.

So, too, there are various other ways in which a student in meeting the entrance requirements may by his selection of the subjects presented either lighten his later college work, or may so handicap himself as to make it difficult to secure an engineering degree in five years. For a general suggestion on this point, consult page 14.

A candidate may be admitted to the College of Engineering as a regular student with not more than two units of condition, but entrance conditions, if any, must be made up during the first year of residence.

Admission to the College of Engineering may be by certificate or by examination. Candidates for admission must be at least sixteen years of age. Graduates of accredited academies or high schools should obtain certificates of work done, showing the ground covered and the grade received in each study. These certificates should be sent to the Registrar, College of Engineering, at least one week before the opening of the fall semester. It is advisable to send them in much earlier. Certificate blanks may be had on request. Candidates who cannot present such certificates may be admitted on examination. Examinations for this purpose will be held September 25, 1916. The Board of Examiners will accept, in lieu of its examinations, those conducted by the College Entrance Examination Board. These are held annually in Chicago, in the Northwestern University Building, and applications should be filed with the Secretary of the Board, Hamilton Hall, New York City, at least five weeks before the date of the examination. The date fixed for examinations in 1916 is June 19 to 24.

ADVANCED STANDING

Students from other colleges seeking admission to this college must present evidence of honorable dismissal from the institution last attended and must present certificates showing (1) a full record of the applicant's preparation for college, (2) his college record, subject by subject, with the grade obtained in each subject and the year of the course in which it was taken. He should submit a catalog of his college, bearing his name, and of the issue current at the time of his admission to that college. Students from other colleges must first meet the entrance requirements to this college, after which the amount of advanced credit to be obtained by certificate will be estimated by a committee of the Faculty, but not finally placed to his credit until the student has been in residence in this college for one semester. Advanced credit without examination will be given only for work done in an approved college. Claims for advanced credit must be made during the first year of residence and not later than September of the collegiate year in which the candidate expects to graduate.

College credit for work done in a secondary school in excess of the requirements for admission can be given only on examination provided through the Registrar's office, and on the basis of five semester hours of credit for one unit of work. An exception to the examination rule is made in foreign language subjects continued in college during the first year, where the subsequent work is a sufficient test of the quality of the earlier work. Applications for such credit and for examination must be made to the Registrar during the first semester of residence and the examination must be taken at one of the regular dates set, viz.: the Wednesday of the opening week in September, or the Saturday following regular examinations in February. Advanced credit can be allowed only in Mathematics, foreign languages, or such other subjects taken in the last year of the secondary school course as may be approved by the Committee on Advanced Standing. No examination for advanced credit will be allowed after the first year of residence nor in subjects foreign to the college curriculum.

Courses of Study

The College of Engineering offers two courses of study, each five years in length, one in Mechanical and Electrical Engineering and the other in Civil Engineering. These courses are alike in character and the same in content to the end of the third year.

For the satisfactory completion of the first four years of either course, the degree, Bachelor of Science, will be given by the College of Liberal Arts.

The degree, Electrical Engineer, will be given by the College of Engineering at the end of the five-year course in Mechanical and Electrical Engineering, and the degree, Civil Engineer, at the end of the five-year course in Civil Engineering.

COURSE IN MECHANICAL AND ELECTRICAL ENGINEERING

	Semester Hours	
Freshman Year	First Semester	Second Semester
English A1	3	3
French A	3	3
Physics A	4	4
Mathematics A3	5	5
Mechanical Drawing, Engineering A1, or Shop Work, Engineering A2	2	..
Mechanical Drawing, Engineering A1, or Shop Work, Engineering A2	..	2
Summer Work	..	2
Sophomore Year		
German A	3	3
Physics B1	3	3
Calculus, Mathematics B1	3	3
Chemistry A	4	4
Surveying, Engineering B2	3	3
Shop Work, Engineering B1	1	1
Summer Surveying, Engineering B3	..	6

	Semester Hours	
Junior Year	First Semester	Second Semester
Economics A	3	3
Physics C1	3	3
Chemistry B1	4	..
*Chemistry B2	..	4
Geology A1	4	..
*Geology A3 or B9	..	4
Descriptive Geometry, Kinematics, and Graphical Statics, Engineering C1	3	3
Summer Work	..	2
Senior Year		
English B1	2	2
Structural Mechanics, Engineering D3	3	3
Calculus, Mathematics C1	3	3
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Electrical Engineering, Engineering D6	3	3
Elective	3	3
Summer Work	..	2
Fifth Year		
Hydraulic Engineering, Engineering E4	3	3
Thermodynamics, Engineering E1	4	..
The Public Relations of Engineers, Engineering E2	..	2
Thesis, Engineering E7	2	4
Engines, Engineering E3	3	3
Advanced Electrical Engineering, Engineering E5	3	..
Electric Power Plant Engineering, Engineering E6	..	3
Elective	2	2

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*The student may omit either Chemistry B2 or the second semester of Geology.

COURSE IN CIVIL ENGINEERING

The first three years of this course are the same as those in the course in Mechanical and Electrical Engineering shown above.

	Semester Hours First Semester	Semester Hours Second Semester
Senior Year		
English B1	2	2
Structural Mechanics, Engineering D3	3	3
Calculus, Mathematics C1	3	3
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Electrical Machinery, Engineering D5	3	..
Heat Engines, Engineering D4	..	3
Elective	3	3
Summer Work	..	2
Fifth Year		
Hydraulic Engineering, Engineering E4	3	3
Railroad Engineering, Engineering E10	4	..
The Public Relations of Engineers, Engineering E2	..	2
Thesis, Engineering E7	2	4
Structures, Engineering E9	5	..
Bridges, Engineering E8	..	5
Elective	3	3

Each course may be taken precisely as shown above by a student who enters the College with the standard preparation which includes English three units, Algebra one and one-half units, Plane Geometry one unit, Solid Geometry one-half unit, French two units, and German two units. If however the student enters College deficient in any of the subjects enumerated in the preceding sentence and the deficiency is not counterbalanced by excess elsewhere in his preparation of the character indicated later in this paragraph, it will

be impossible for him to complete either engineering course in five years without securing more than an average of seventeen semester hours of credit in each semester. Only an exceptionally strong student may expect to secure more than seventeen hours of credit per semester. Certain subjects when accepted for entrance credit constitute an excess in the sense that they relieve the student offering them of some college work which would otherwise be required of him in the engineering courses. These are College Algebra, Plane Trigonometry, Chemistry, a second unit of Mechanical Drawing, a second unit of Manual Training, and such preparation in foreign language as will leave the student less than twelve semester hours of foreign language to be taken in college in order to meet the requirements for the degree of Bachelor of Science which are shown in the Catalog of the University. As an example it may be stated that a student who presents three units of German or Latin, and two of French, is required to take in college French A only, six semester hours, instead of both French A and German A as listed above, twelve semester hours.

For recitations or lectures one semester hour of credit is given for one period, fifty minutes, each week, during one semester. For shop work, drafting or laboratory work, one semester hour of credit is given for one three-hour period each week during one semester.

REQUIRED SUMMER WORK

During each of the three summers following the first, third and fourth years the student is required to do practical work for at least six weeks, of such a character as to furnish experience of value to him as a prospective engineer. The credit assigned to six weeks of such approved work is two semester hours.

Under this requirement, students have acted as rodmen on city surveys, rodmen on the United States Lake Survey, workers in the tool room of a factory, helpers in the installation of heavy machinery in a new steam-electric power plant, foremen of gangs of laborers, helpers in the wiring of telephone switchboard, assistants in cement testing, computers for the Carnegie Institution, inspectors with a

company engaged in electric lighting and power distribution, and have worked on milling and machine work, figuring estimates, making tracings, and on land and topographical surveys.

During the summer following the second year the student is required to do field work in surveying for six weeks immediately following commencement, Engineering B3, credit six semester hours. This is a regular college course under the direction of college professors, taken at a summer camp established for that purpose.

DESCRIPTION OF COURSES

The following paragraphs give more specific information in regard to the separate courses enumerated above as together constituting the courses in Mechanical and Electrical Engineering and in Civil Engineering.

English A1. Composition and Rhetoric; Brief Survey of English Literature—Required of all students in their first year. Three semester hours throughout the year.

English A2. Composition and Rhetoric—Required of students whose preparation is found to be insufficient for English A1. The work of the first semester is continued two hours a week in the second semester and attendance is required until the student's work is brought consistently up to a satisfactory standard.

French A. Modern French—Fraser and Squair's Grammar, Part II. Composition, conversation, and dictation. Reading: Schintz's Selections from Maupassant; Daudet's Tartarin de Tarascon; Augier's Le Gendre de M. Poirier; Pailleron's Le Monde où l'on s'ennuie; Hugo's Quatre-Vingt Treize and Hernani; Balzac's Eugénie Grandet; Canfield's French Lyrics. Three semester hours throughout the year. Open to students who present two units of French for entrance. If the student has presented no French for entrance he must take French AA, five semester hours throughout one year, in college before being admitted to French A, or if he has presented one unit of French for entrance, he must ordinarily take French AB, three semester hours throughout one year, in college before being admitted to French A.

German A. Intermediate German—Modern prose writers, classic drama and lyrics. Three semester hours throughout the year. Open to students who present two units of German for entrance. If the student has presented no German for entrance he must take German AA, five semester hours throughout one year, in college before being admitted to German A, or if he has presented one unit of German for entrance he must ordinarily take German AB, three semester hours throughout one year, in college before being admitted to German A.

If the student has offered for entrance two units of French and two of German, he is advised to take French A in the first year and German A in the second year, but the order may be reversed. If other language units than those named in the preceding sentence have been offered for entrance, the student is required to take such language courses as will satisfy the language requirement for the degree of Bachelor of Science. These are not necessarily the courses French A and German A. For example, if a student has presented two or three units of Latin or of Greek for entrance he may be released, both as to entrance credits and as to college work, from a part of French or German. For complete information on this point, consult the statement of prescribed courses for the degree of Bachelor of Science, in the University catalog.

Mathematics A3. Plane Trigonometry, Algebra and Analytical Geometry—This is a course in which Plane Trigonometry, Algebra and Analytical Geometry are given together in one continuous course. Open to students who have presented one and a half units of Algebra for admission. Five semester hours throughout the year.

If a student has presented College Algebra or Plane Trigonometry for entrance, instead of taking Mathematics A3 in the freshman year, he is required to take three semester hours in each of two semesters in courses so arranged that with the work offered for entrance they will be equivalent to Mathematics A3.

Mathematics B1. Differential and Integral Calculus—A first course in Calculus, including its simpler applications. Open to students who have completed Mathematics A3, or an equivalent. Three semester hours throughout the year.

Mathematics C1. Advanced Calculus—Infinite series; Taylor's theorem; partial differentiation; differential geometry; definite integrals over curves, surfaces and volumes; the Eulerian functions; Fourier's series; differential equations. Open to students who have completed Mathematics B1. Three semester hours throughout the year.

Physics A. General Physics—First semester—General properties of matter, wave-motion, sound, heat. Second semester—Electricity, magnetism, light. An introductory course requiring no mathematics beyond the requirements for entrance to college, intended to acquaint the student with the elementary facts, the method, and the general principles of physical science. Text-book: Crew's General Physics. Three lectures and one laboratory exercise each week. Open to all students. Four semester hours throughout the year.

Physics B1. Mechanics—An elementary experimental study of forces, moments of force, moments of inertia, elasticity, hydromechanics, an introduction to advanced Physics and Engineering. This is a course in pure Dynamics, and serves as an introduction to Applied Mechanics. Text-book: Crew's Principles of Mechanics. Two lectures and one laboratory exercise each week. The laboratory work is guided by specially prepared instructions. Open to students who have completed Physics A, or its equivalent, and who have completed or are taking Mathematics B1. Three semester hours throughout the year.

Physics C1. Electricity and Magnetism—The more general laws of electricity and magnetism are discussed; the practical equations employed in the laboratory are derived and discussed. Text-book: Starling's Electricity and Magnetism. The laboratory work includes the measurement by one or more methods of current, resistance, electromotive force, temperature-coefficients, capacity; a study of the magnetic properties of iron and steel, thermoelectric effects, the use of the electrometer, the Carey Foster bridge, potentiometer, copper coulometer, etc. Open to students who have completed Mathematics B1 and who have completed or are taking Physics B1. Two lectures and one laboratory exercise each week. Three semester hours throughout the year.

Chemistry A. General Chemistry, Elementary—Text and laboratory work. Open to all students. Four semester hours throughout the year.

Chemistry AB. General Chemistry—To supplement the high school course, making the total equivalent to Chemistry A. Open to students who present one unit of chemistry for admission. Four semester hours in the first semester only.

Chemistry B1. Qualitative Analysis—Analysis of simple mixtures accompanied by lectures and quizzes. Recitations and laboratory work. Open to students who have completed Chemistry A or an equivalent. Four semester hours for one semester, to be taken in either semester.

Chemistry B2. Organic Chemistry—Lectures and quizzes on the hydrocarbons and their derivatives. Laboratory preparation and study of typical organic compounds. Recitations and laboratory work. Open to students who have completed Chemistry A and B1 or an equivalent. Four semester hours for one semester, to be taken in either semester.

Geology A1. General Geology—A general introduction to Geology. Lectures, recitations and laboratory work. Open to Sophomores, Juniors and Seniors. Four semester hours for one semester, to be taken in either semester.

Geology A3. Mineralogy—Crystallography, descriptive mineralogy, and determinative mineralogy of the common ores and rock forming minerals. Open to students who have completed in college or in high school a year course in Chemistry. Four semester hours for one semester, to be taken in either semester.

Geology B5. Metallurgy—Fuels, refractory and cementing materials, metallurgy of iron and steel. Open to those students of Engineering who have completed Chemistry A. Two semester hours in the first semester only.

Geology B9. Historical Geology—A history of the earth, with special reference to the evolution of the North American Continent. Open to students who have completed Course A1. Four semester hours in the second semester only.

Economics A. The Elements of Economics—First semester—An examination of the fundamental principles of economics. Second semester—Application of these principles to practical problems. Throughout the course special attention is given to the relation between theory and practise. Open to Sophomores, Juniors and Seniors. Three semester hours throughout the year.

English B1. English Literature; Composition—Lectures, recitations, written reports and themes, and reading. Open to students who have completed the required English of the first year. Two semester hours throughout the year.

Electives—Six semester hours of electives are provided for in the senior year of the Mechanical and Electrical Engineering course and four in the fifth year. In the fourth and fifth years of the Civil Engineering course a total of twelve hours of electives are required. These electives are limited to courses given in the College of Liberal Arts, the choice to be approved by the Director.

Engineering A1. Mechanical Drawing—An elementary course in the technique of mechanical drawing, requiring no previous knowledge of drawing. Freehand lettering, exercise drawing, freehand sketching, shop drawing in pencil, tracing in ink on tracing cloth. Open to all students. Two drawing periods each week. Two semester hours for one semester, to be taken in either semester.

Engineering A2. Freshman Shop Work—A series of elementary practical exercises in the shop, upon a wide variety of subjects, the object being to bring out the principles involved, to acquaint the student with a considerable range of mechanical experience, and to cultivate habits both of logical thinking and of accurate work. The exercises involve some wood turning, pattern making, filing, scraping, sawing, punching, riveting, brazing, metal turning, shaping, planing, milling, grinding, etc. These exercises are guided by assigned readings, blue-printed instructions and by lectures on mechanical princi-

ples and processes, with occasional written work. Open to all students. Two shop periods each week. Two semester hours for one semester, to be taken in either semester.

Ordinarily it is expected that an engineering student will take Engineering A1 in one semester and Engineering A2 in the other semester of his freshman year.

Engineering B1. Sophomore Shop Work—This is a more intensive course than Engineering A2, limited mainly to pattern work, machine work, and tool making. The work is upon problems rather than exercises, and in them the student is given an opportunity to show his ingenuity and his grasp of the subject; while his work is directed in a general way, he is not given detailed instructions. The objects made are generally parts of some machine; this emphasizes the need for accuracy and gives a practical turn and interest to the subject. The work naturally introduces the student to a somewhat advanced knowledge of machines and processes. Open to students who have completed Engineering A2. One shop period each week. One semester hour throughout the year.

Engineering B2. Surveying—The use of chains, tapes, compass, level, transit, and plane table; methods of land, topographic and hydrographic surveying, including stream measurement, mine surveying and city surveying. Text-book: Theory and Practice of Surveying, by J. B. Johnson and L. S. Smith. Open to students who have completed Engineering A1 and Mathematics A3. Two recitations and one field period each week. Three semester hours throughout the year.

Engineering B3. Summer Surveying—Applications under actual field conditions of the theory taught in Engineering B2. The outcome of the work will be a map of the region covered by the survey and much allied information. A new area will be covered each year, ordinarily adjacent to the area surveyed in the preceding year. The survey camp in 1915 was established in the Fox Lake region in Illinois, near Antioch. Six weeks immediately following commencement. Open to students who have completed Engineering B2. Credit six semester hours.

Engineering C1. Descriptive Geometry, Kinematics and Graphical Statics—The course is divided into three equal parts: (1) Descriptive Geometry; first principles; point, line and plane. Text-book: Essentials of Descriptive Geometry, by Phillips and Millar. (2) Kinematics; elementary propositions; communication of motion by rolling and sliding contact, by link work, by wrapping connectors. Text-book: Elementary Mechanism, by Stahl and Woods. (3) Graphical Statics; general principles; concurrent and non-concurrent forces; moments; roof trusses; loads; reactions; stresses; wind load stresses; cantilever and unsymmetrical trusses. Text: Graphic Statics, by Malcolm. Open to students who have completed Engineering A1 and Mathematics A3. One recitation period and two drawing periods each week. Three semester hours throughout the year.

Engineering D1. Contracts and Specifications—The course deals with contracts and specifications as applied to engineering only. Recitations and lectures. Text-book: The Law of Contracts, by John C. Wait. Open to students who have sixty hours of credit. Two semester hours in the second semester only.

Engineering D2. Journal Meeting—The time is spent in reading and reviewing current engineering literature, the object being to acquaint the student with this fund of information, to show him the necessity of judicious selection from the great mass of such current literature, to indicate methods of selection, and to cultivate a habit of accurate reading. Open to students who have taken or who are taking Engineering D3, D4, D5, or D6. One laboratory period each week. One semester hour throughout the year.

Engineering D3. Structural Mechanics—The text-book work is upon the application of mechanics to the elementary parts of structures, taking up properties of materials, testing materials, elementary theory of elasticity, stresses and strains of beams, columns, shafts, tubes, curved bars, springs and bodies in rapid rotation; stability of piles and retaining walls; elementary theory of reinforced concrete. The laboratory work relates partly to standard methods of testing

materials such as steel and cement, but it is largely involved in an effort to bring to the clear comprehension of the student the various relations deduced in the text-book work upon the subject. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering D4. Heat Engines—A course in prime movers and general power plant equipment. Elementary thermodynamics. Construction and operation of steam engines, turbines and gas engines. Engine testing. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours in the second semester only.

Engineering D5. Electrical Machinery—A course in Direct and Alternating Current Machines. Special emphasis is placed upon the study of the fundamental principles involved and upon the application of these principles in practise. Open to students who have completed Mathematics B1 and Physics C1. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering D6. Electrical Engineering—First semester—A general study of the fundamental principles of Electrical Engineering and their applications to direct current machinery. A selected series of problems are assigned to illustrate quantitatively the principles involved. Second semester—A general study of the fundamental principles of single and polyphase alternating currents, with special reference to analytic and graphic methods of treatment. Elementary analysis of alternating current machinery. Open to students who have completed Physics C1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E1. Thermodynamics—The course consists of text-book work first upon the general theory of thermodynamics, and later upon its application to heat engines, taking up properties of gases, flow of gases, thermodynamics of air engines, internal combustion engines and air compressors, properties of steam and other

vapors, thermodynamics of steam engines and steam turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Four semester hours in the first semester only.

Engineering E2. The Public Relations of Engineers—A course of lectures and reading dealing with the relations of a practising engineer to other men. It will deal in part with biographies of engineers, the history of engineering, the purpose of organization and the conservation of natural resources. Open to students who have taken or who are taking Engineering E1, E3, E4, E5, E6, E8 or E9. Two semester hours in the second semester only.

Engineering E3. Engines—A detailed study of the steam engine, steam turbine, boiler plant equipment, gas engines and producer gas plants. Open to students who have taken or who are taking Engineering E1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E4. Hydraulic Engineering—The theory and application of the principles of hydrostatics and hydrodynamics; measurements of flow by pressure gauges, meters, Pitot tubes and weirs; path, energy and impulse of jets; flow through orifices, tubes and pipes with loss of energy or head due to contractions, expansions and nozzles; derivation and application of formulæ for discharge, velocity and pressure; work derived from moving vanes as in water wheels and turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E5. Advanced Electrical Engineering—Advanced analysis by the analytic and graphic methods of treatment of continuous and alternating current machinery, of general alternating current and of transient phenomena. Lectures, assigned reading, recitations and laboratory work. Open to students who have completed Engineering D6. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering E6. Electric Power Plant Engineering—A study of special problems in connection with the generation and transmission of electrical energy in large systems and in high potential systems. Emphasis is laid upon the proper relation of parts to form a complete plant. Lectures, assigned reading, recitations and laboratory work. Open to students who have completed Engineering E5. Two recitations and one laboratory period each week. Three semester hours in the second semester only.

Engineering E7. Thesis—Open to students in the last year in the Engineering course. Two semester hours in the first and four in the second semester.

Engineering E8. Bridges—A general course on the theory and design of bridges, taking up stone arches, reinforced concrete arches, culverts and steel bridges of many types. Open to students who have completed Engineering D3. Three recitations and two drawing periods each week. Five semester hours in the second semester only.

Engineering E9. Structures—A general course on the theory and design of foundations, retaining walls, tall chimneys, masonry dams and building construction. Open to students who have completed Engineering D3. Three recitations and two drawing periods each week. Five semester hours in the first semester only.

Engineering E10. Railroad Engineering—The use of the transit, chain, level, etc., in laying out simple, compound and vertical curves; methods of reconnaissance, preliminary and location surveys; turnouts, switches and wye tracks; profile and cross section surveys, and computation of earthwork; haul and mass diagrams; maps and drawings; the use of topographic surveys in location; drainage, waterways and bridge staking. Economic theory of railway location, construction, extension and maintenance. Field work consists of laying out a short line and of the practical application of methods of staking, computation and mapping given above. Open to students who have completed Engineering B2 and Mathematics B1. Three recitations and one field period each week. Four semester hours in the first semester only.

General Regulations

REGISTRATION

Every student is required to register in person at the office of the Registrar, College of Engineering, before entering upon college work, on the registration days specified in the calendar. Returning students who register after the close of this period are subject to a fee of two dollars.

On the registration days of the first semester the student must register for the work of the whole year. Changes may be made only with the consent of the Director. A course dropped without consent is regarded as a failure and is so recorded.

At the time of registration the student obtains from the Registrar his tuition bill for the semester. This must be presented immediately at the Business Manager's Office for payment.

CLASSIFICATION

Students in the College of Engineering are grouped in five classes according to their credits in the office of the Registrar. The basis for their classification is as follows:

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first four years, and who have satisfied all entrance requirements, are classed as fifth year students.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first three years, and who have satisfied all entrance requirements, are classed as seniors.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first two years, and who have satisfied all entrance requirements, are classed as juniors.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first year, and

who have satisfied all entrance requirements, are classed as sophomores.

All other regular students are classed as freshmen, without regard to the date of admission.

GRADES OF SCHOLARSHIP, EXAMINATIONS, AND ATTENDANCE

In other matters of student regulation, such as examinations, grades of scholarship, class and chapel attendance, and physical training, the students of the College of Engineering are governed by the regulations stated in the general University Catalog and in the Undergraduate's Manual.

FEES AND EXPENSES

Registration Fee, paid by every student at the beginning of each semester	$ 5.00
Tuition and Incidentals, per year, except for Fifth Year students	110.00
Tuition and Incidentals, per year, for Fifth Year students	40.00

Tuition and Incidentals are payable one-half at the beginning of the first semester, one-half at the beginning of the second.

Laboratory Fees.

Chemistry A or B1	$11.50 a semester
Chemistry B2	14.50 a semester
Geology A1	2.00 a semester
Physics A or B1	2.00 a semester
Physics C1	3.00 a semester
Engineering A1	6.00 a semester
Engineering A2	8.00 a semester
Engineering B1	4.00 a semester
Engineering B2 or D3	5.00 a semester
Engineering C1, D4, D5, D6, E3, E4, E5, E6, E8, E9 or E10	3.00 a semester
Student Enterprise Fee	2.50 a semester
Fee for summer surveying course, Engineering B3	15.00
Diploma Fee	10.00

The laboratory fees for engineering courses are intended to cover ordinary depreciation of apparatus and the use of materials. The student is held responsible for any damage due to his negligence.

Laboratory fees are not refunded if the student continues in a course as long as two weeks, except that in the Chemical Laboratory the fee is in the nature of a deposit, and an account is kept of the material used, the unexpended balance at the end of the year being returned to the student.

The tuition fees will not be refunded except in case of sickness. If a student withdraws before the middle of the semester, on account of serious illness, one-half of his tuition fee will be refunded, on his obtaining from the Director a statement of honorable standing, and from a physician a certificate that his health will not permit him to remain in attendance. The student will also be required to return his receipted bill for tuition.

Reduced rates of tuition are given to sons of clergymen who are actively pursuing the work of the ministry ($33.00 per semester) and to holders of old-time perpetual or transferable scholarships, for incidentals ($32.50 per semester).

The remaining necessary expenses of a student, namely, board, room, laundry, text-books and stationery, for nine months, vary from $280 to $460, the average being about $360.

Students find comfortable homes in private families or live in club houses under their own management. Clubs are formed in which the cost of table board is reduced to a minimum.

DORMITORIES

A new system of thirteen dormitories for men students is now in use. Nine of these buildings are designed for fraternities, whose alumni have contributed toward their cost, and the remaining four are open for rental by any of the men students of the University.

The buildings are architecturally beautiful and are meant to be models in comfort and sanitation. They are fireproof, lighted by electricity, and heated by steam. On the first floor of each building is a large enclosed porch, and a well equipped club room with an open

fire-place, rugs, tables, and lounging chairs. There are also a few rooms for individual students on this floor. The second and third floors are made up entirely of single rooms.

Each student's private room is furnished with a single bed, mattress and pillow, a chiffonier, a combined study table and bookcase, two chairs, a rug, and window shades. The student furnishes his own bedding and towels, but the University takes charge of the laundering of these. In the interest of economy, electric lighting is not included in the general charge, but is apportioned pro rata monthly to the occupants of the building.

In the men's dormitories room rent is payable at the beginning of each semester and the charge to each student for the use of a furnished single room, including care, heat and water, varies from ninety to one hundred and ten dollars a year. The rental for private rooms on the first floor is somewhat higher.

The Registrar of the College of Liberal Arts is the renting officer of the dormitories; and men of the College of Engineering not living at their homes or in fraternity houses are required to live in the dormitories unless no rooms are available, or they obtain through the Registrar written permission to room elsewhere. Blank application forms for such permission will be furnished on request.

A chart showing the location and rental prices of rooms may be had from the Registrar upon application.

SCHOLARSHIPS

A few scholarships, which cover tuition, are awarded annually (five in 1915-1916) to select members of the incoming class, upon applications endorsed by the principal and faculty of the secondary school from which the applicant graduates. The applicant must meet the full entrance requirements and must present certificates from the teachers in his secondary school for excellence of character and scholarship, for physical vigor, manliness and promise of usefulness as a citizen. The award is made at the University by a committee of the College faculty.

A few scholarships, which cover tuition, are awarded annually (four in 1915-1916) to select members of the upper classes.

The upper class scholarship known as the *Swift Scholarship* has been given by Mrs. Gustavus F. Swift to members of the upper classes.

OPPORTUNITIES FOR SELF-HELP

Some students in Evanston have been able, while in college, to earn the cost of their living in full, and every year a large percentage earn a considerable portion of their expenses, and at the same time maintain a high standing in their studies. It is never advisable, however, for a student to undertake more work of this kind than is necessary for his personal support, and if the amount is excessive he should plan to give more than the normal five years to his college course.

The General Secretary of the Young Men's Christian Association maintains a bureau to assist students in finding employment. The positions most frequently open to young men are those as waiters at boarding places or as attendants in private houses in the care of gardens or furnaces. While the aggregate of the annual earnings of students is a large sum, the number of positions open is limited and no assurances can be given that employment will be found. Only the most faithful and self-reliant students should undertake self-support, and in no case should a student come to Evanston without sufficient means to meet expenses for at least a half-year.

RELIGIOUS AND SOCIAL LIFE OF STUDENTS

The charter of the University provides that "no particular religious faith shall be required of those who become students of this institution." Students are expected to attend public worship on Sunday in the church of their choice. Chapel service is held at ten o'clock on each week day, except Saturday, throughout the college year. Attendance upon at least two-fifths of these services is required. Under the direction of the Young Men's Christian Association religious meetings are held each week.

In athletics, in social life and in the use of the buildings, there is no separation of the students of Engineering from the students of Liberal Arts. Engineering students go to the various buildings of

the College of Liberal Arts for recitations in other than strictly engineering subjects. They share in the use of the University Library. They have free access to the new gymnasium, the largest in the United States. Their social life is mingled with that of the Liberal Arts students in one university group.

The Engineering Society, composed of students of engineering and members of the engineering faculty, provides numerous addresses by prominent engineers and organizes inspection trips to points of engineering interest. The members also furnish many additional programs so that the society holds a meeting nearly every week.

An Engineering Assembly, attended by all students of engineering and by the engineering faculty, occurs eight times during each year. The general purpose of these assemblies is to develop a group consciousness in the students of engineering and to bring forward matters of especial interest to the group.

Some Advantages of the College of Engineering at Northwestern University

It offers a thorough professional course rather than a purely practical course. It places the emphasis on the fundamentals which are common to all branches of engineering. It trains its graduates for unlimited growth as engineers and for possible leadership.

The engineering courses, five years in length, are so arranged as to give each man his general broad training at the same time that he pursues his engineering studies. The engineering students are closely associated with the larger group of Liberal Arts students, of which they, in fact, form a part.

In the purely engineering part of the course, the proportion of professors to students is much larger than is customary and each student, therefore, receives an unusual amount of attention.

There is more engineering in progress within fifty miles of the loop district of Chicago than in any area of the same size anywhere in the United States with the possible exception of New York City.

The students of this College thus have an unsurpassed opportunity to keep in touch with engineering practise and to meet engineers.

The College of Engineering is a young organization in excellent condition to take advantage of the experience of other colleges in training engineers.

It is provided with ample shop and laboratory equipment, selected with unusual care and deliberation, purely for teaching purposes and housed in an excellent building.

Inquiries for further information, requests for the catalog of the University, for scholarship application blanks, and for blank forms of certificates from secondary schools may be addressed to John F. Hayford, Director, College of Engineering, Northwestern University, Evanston, Illinois.

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Northwestern University

¶ THE COLLEGE OF LIBERAL ARTS, located at Evanston, in an ideal college community, offers special preparation for the professions and for pursuits requiring broad training.

¶ THE MEDICAL SCHOOL is one of the oldest, largest, and best equipped. Seven hospitals are open to students. Clinic material is abundant.

¶ THE LAW SCHOOL, the oldest law school in Chicago, offers unexcelled library facilities and courses that prepare for practise in any state.

¶ THE COLLEGE OF ENGINEERING has its own building, completed in 1909, beautifully situated, a model of efficiency. Technical studies in a University environment.

¶ THE SCHOOL OF PHARMACY offers a scientific training in Pharmacy, Chemistry, and Drug and Food Analysis. Special courses for Drug Clerks.

¶ THE DENTAL SCHOOL offers expert training in theory and practise. Facilities are unsurpassed. Its clinic is the largest in the world.

¶ THE SCHOOL OF MUSIC affords a scientific preparation for music as an accomplishment and a profession. It is located at Evanston.

¶ THE SCHOOL OF COMMERCE offers professional and scientific education for business with emphasis on the training of business executives. Day and evening work, laboratory courses and business research.

¶ THE SCHOOL OF ORATORY has its own building and a faculty with long and successful experience.

¶ EVANSTON ACADEMY prepares for college, for engineering, for professional schools and for business.

For information regarding any school of the University, address President A. W. Harris, Northwestern University Building, Chicago.

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Northwestern University Bulletin

COLLEGE *of* ENGINEERING ANNOUNCEMENTS
1917-1918

Published Weekly by Northwestern University
Northwestern University Building
CHICAGO

Vol. XVII, No. 43 June 30, 1917

NORTHWESTERN UNIVERSITY

Special Advantages of the College of Engineering

A thorough professional course rather than a purely practical one, with five years of broad training.

Small classes in which each student receives an unusual amount of individual attention.

A splendid building designed for the purpose, and up-to-date apparatus carefully selected to promote effective teaching.

Accessibility to great engineering projects, with unsurpassed opportunities to meet engineers and keep in touch with engineering practise.

A young thriving college in an old university.

Northwestern University Bulletin

COLLEGE *of* ENGINEERING ANNOUNCEMENTS
1917-1918

Published by the University
June, 1917

SWIFT HALL OF ENGINEERING

Swift Hall of Engineering, the gift of Mrs. Gustavus F. Swift and her son, Edward F. Swift, was dedicated in 1909. The building measures fifty-eight by one hundred and twenty-six feet; the exterior is of Bedford limestone, and presents architectural lines that are of the best; the interior is a model of appropriate decoration, convenience, safety and strength; it has concrete floors and stairways throughout. It presents five working stories, all well lighted and of good height, while the large rooms at the ends of the building are free from columns. From the beginning, it was especially planned as the home of the College of Engineering. The building is in a delightful location overlooking Lake Michigan.

Faculty

THOMAS FRANKLIN HOLGATE, Ph.D., LL.D.
President *ad interim*

JOHN FILLMORE HAYFORD, C.E.
Director

OLIN HANSON BASQUIN, Ph.D.
Professor of Applied Mechanics

WILLIAM CHARLES BAUER, B.S., Sc.D.
Professor of Electrical Engineering

HERBERT SHAW PHILBRICK, B.A., B.S.
Professor of Mechanical Engineering

WILLIAM HENRY BURGER, B.S.
Professor of Civil Engineering

MILBY ROY HAMMER, B.S.
Associate Professor of Drawing

JAMES TAFT HATFIELD, Ph.D.
Professor of German Language and Literature

HENRY CREW, Ph.D.
Professor of Physics

EDOUARD PAUL BAILLOT, L.H.D.
Professor of Romance Languages

ULYSSES SHERMAN GRANT, Ph.D.
Professor of Geology

ARTHUR CHARLES LEWIS BROWN, Ph.D.
Professor of English

WILLARD EUGENE HOTCHKISS, Ph.D.
Professor of Economics

DAVID RAYMOND CURTISS, Ph.D.
Professor of Mathematics

WALTER LICHTENSTEIN, Ph.D.
Librarian

WILLIAM FRANK BRYAN, Ph.D.
Associate Professor of English

MURRAY ARNOLD HINES, Ph.D.
Assistant Professor of Chemistry

ELTON JAMES MOULTON, Ph.D.
Assistant Professor of Mathematics

KEITH KUENZI SMITH, Ph.D.
Assistant Professor of Physics

GEORGE VEST MCCAULEY, Ph.D.
Assistant Professor of Physics

CLARENCE STEPHEN MARSH, B.A.
Registrar

DOROTHY LEWIS SAGE
Assistant Registrar

ANDREWS ALLEN, C.E.
Lecturer on Contracts and Specifications

ELMER MARTIN LIESSMANN, LL.B.
Lecturer on Contracts and Specifications

ARTHUR WALD
Shop Assistant

Calendar

1917-1918

1917		
Sept. 24	Mon.	Academic year 1917-1918 begins; examinations for admission; first day of registration
Sept. 26	Wed.	Second examinations
Sept. 27	Thu.	Class work begins
Nov. 29	Thu.	Thanksgiving Recess, to December 2, inclusive
Dec. 20	Thu.	Christmas Recess, to January 2, Wednesday, inclusive
1918		
Jan. 3	Thu.	Class work resumed
Jan. 28	Mon.	Mid-year examinations begin
Feb. 9	Sat.	Second examinations; last day of registration for second semester
Feb. 11	Mon.	Second semester begins; class work resumed
Feb. 22	Fri.	Washington's Birthday
Mar. 29	Fri.	Easter Recess, to April 1, Monday, inclusive
Apr. 1	Mon.	Second examinations
May 27	Mon.	Regular examinations begin
May 30	Thu.	Memorial day
June 12	Wed.	SIXTIETH ANNUAL COMMENCEMENT
June 13	Thu.	Beginning of summer surveying
July 24	Wed.	End of summer surveying

Historical Note

THE charter of Northwestern University was signed by the Governor of Illinois on January 28, 1851. The corporation consists of forty-two trustees. An amendment to the charter provides that no intoxicating liquors shall be sold within four miles of the University.

The trustees selected as the seat of the University a tract of land on the shore of Lake Michigan, twelve miles north from the heart of Chicago. Here in 1855 the first University building was erected and about its location has grown up the City of Evanston. Here are the College of Liberal Arts, the College of Engineering, the School of Music, and the School of Oratory. The schools of Medicine, Law, Dentistry and Commerce are located in the City of Chicago.

The College of Liberal Arts, the oldest department of the University, was opened to students in the fall of 1855. From its small beginning it has grown, not by rapid expansion or by large benefactions, but by steady gains along conservative lines—each of its sixty years adding some improvements to its physical and educational equipment. The work of the College of Liberal Arts is mainly directed toward furnishing opportunities for a liberal culture or general education. The regulations affecting the choice of studies are such that the student may elect a large part of his work along lines in which he is especially interested.

In recent years a demand for instruction in engineering gradually made itself felt. A gift for the erection of an engineering building at Evanston and for its endowment led the Trustees of the University to take action in June, 1907, resulting in the establishing of a College of Engineering. This gift came from Mrs. Gustavus F.

Swift and her son, Edward F. Swift. The building, known as the Swift Hall of Engineering, was dedicated in May, 1909. It is now occupied by the College of Engineering. The Department of Mathematics of the College of Liberal Arts also has offices and recitation rooms in the building.

In 1916-1917, the College of Engineering had a total registration of one hundred and four students.

STATEMENT OF PURPOSE

The purpose of the College of Engineering of Northwestern University is to furnish to each student a thorough training for the profession of engineering, combined with a general training of the man. The College aims to train engineers for the greatest average effectiveness in a lifetime rather than for the greatest effectiveness in the first year after graduation. It aims to develop a capacity for unlimited growth. Hence strong emphasis is laid on those studies which tend to develop the man as well as on those which furnish training in engineering.

In keeping with these ideals, the courses in engineering introduce an unusual number of those non-technical studies that serve to give a general education and to develop the thinking power of the students. Unusual stress is laid upon Mathematics, upon Physics and other sciences fundamental to engineering and upon the principles which are broadly applicable to all engineering. The courses are five years in length, because past experience among colleges of engineering shows that four years is too short a time for the thorough professional training contemplated. At the end of four years the student of engineering will have secured as thorough a general training as one who comes to Northwestern University for general training alone. In recognition of that fact, he will be given the degree of Bachelor of Science by the College of Liberal Arts. During the fifth year the general training of the student is continued and he completes his professional course in engineering.

The motto of the College is "Culture for Usefulness." This motto calls for an effort to obtain for the student the broadest

culture attainable in five years in order to equip him, as a man and as an engineer, for the greatest possible usefulness in the world in the united struggle of man for progress.

Requirements for Admission

Candidates for admission without entrance conditions must qualify by examination or by certificate on fifteen units of High School work. The unit is a course of study requiring a daily recitation on a prepared topic for a full school year, and covering in the various subjects the work defined in the University Catalog.

English, three units; Algebra, one and a half units; and Plane Geometry, one unit, are required of all candidates. A choice is allowed in the selection of other subjects, but the choice must include either four units of foreign language or two units of foreign language plus two units chosen from the following group: College Algebra one-half unit, Plane Trigonometry one-half unit, Solid Geometry one-half unit, Physics one unit, Chemistry one unit, Manual Training one or two units, and Mechanical Drawing one or two units. The choice of foreign language is limited to Latin, Greek, French and German and a certain maximum number of units in each as indicated in the table which follows. A single unit of any language will be accepted to meet the specific foreign language requirement only when accompanied by at least three units of some other language or two units each of two others. The remaining five and one-half units required to make an aggregate of fifteen units may include any subjects commonly appearing as a part of a high school course, provided that no subject is presented for less than a half unit of credit. Vocal music and physical training are not recognized for credit.

The following table indicates the subjects commonly presented for admission credit:

Latin	2, 3 or 4	units
Greek	2 or 3	units
German	2 or 3	units
French	2 or 3	units
Spanish	2	units
College Algebra	½	unit
Plane Trigonometry	½	unit
Solid Geometry	½	unit
Physiography	1	unit
Physics	1	unit
Botany	1	unit
Zoology	1	unit
Chemistry	1	unit
Ancient History	1	unit
Mediæval and Modern History	1	unit
English History	1	unit
American History (or with Civil Government)	1	unit
Civil Government	½	unit
Political Economy	½	unit
Commercial Geography	½	unit
Commercial Law	½	unit
Physiology	½	unit
Mechanical Drawing	1 or 2	units
Manual Training	1 or 2	units

One unit of entrance credit in Mechanical Drawing may be given for twelve hours work per week for a full school year, or an equivalent amount of time, provided the work is of an acceptable character. A second unit of credit may be given in Mechanical Drawing only in case the course in drawing taken in school covers the full equivalent of the course Engineering A1 of the College of Engineering.

One unit of entrance credit in Manual Training may be given for twelve hours work per week for a full school year, or an equivalent amount of time, provided the work is of an acceptable character. A second unit of credit may be given in Manual Training only in case the course in Manual Training taken in school covers the full equivalent of the course Engineering A2 of the College of Engineering.

For a statement in detail of the definitions of other entrance units consult the Catalog of the University.

Each student in engineering who has not presented Solid Geometry for entrance will be required to take Solid Geometry, three hours for one semester, in the first year. As this will be an extra task,

making it difficult for the student to keep up with his class, each candidate is advised to present this subject for entrance if possible.

So, too, there are various other ways in which a student in meeting the entrance requirements may by his selection of the subjects presented either lighten his later college work, or may so handicap himself as to make it difficult to secure an engineering degree in five years. For a general suggestion on this point, consult page 14.

A candidate may be admitted to the College of Engineering as a regular student with not more than two units of condition, but entrance conditions, if any, must be made up during the first year of residence.

Admission to the College of Engineering may be by certificate or by examination. Candidates for admission must be at least sixteen years of age. Graduates of academies or high schools should obtain certificates of work done, showing the ground covered and the grade received in each study. These certificates should be sent to the Registrar, College of Engineering, at least one week before the opening of the fall semester. It is advisable to send them in much earlier. Certificate blanks may be had on request. Candidates who cannot present such certificates may be admitted on examination. Examinations for this purpose will be held September 24, 1917.

ADVANCED STANDING

Students from other colleges seeking admission to this college must present evidence of honorable dismissal from the institution last attended and must present certificates showing (1) a full record of the applicant's preparation for college, (2) his college record, subject by subject, with the grade obtained in each subject and the year of the course in which it was taken. He should submit a catalog of his college, bearing his name, and of the issue current at the time of his admission to that college. Students from other colleges must first meet the entrance requirements to this college, after which the amount of advanced credit to be obtained by certificate will be estimated by a committee of the Faculty, but not finally placed to

his credit until the student has been in residence in this college for one semester. Advanced credit without examination will be given only for work done in an approved college. Claims for advanced credit must be made during the first year of residence and not later than September of the collegiate year in which the candidate expects to graduate.

College credit for work done in a secondary school in excess of the requirements for admission can be given only on examination provided through the Registrar's office, and on the basis of five semester hours of credit for one unit of work. An exception to the examination rule is made in foreign language subjects continued in college during the first year, where the subsequent work is a sufficient test of the quality of the earlier work. Applications for such credit and for examination must be made to the Registrar during the first semester of residence and the examination must be taken at one of the regular dates set, viz.: the Wednesday of the opening week in September, or the Saturday following regular examinations in February. Advanced credit can be allowed only in Mathematics, foreign languages, or such other subjects taken in the last year of the secondary school course as may be approved by the Committee on Advanced Standing. No examination for advanced credit will be allowed after the first year of residence nor in subjects foreign to the college curriculum.

Courses of Study

The College of Engineering offers two courses of study, each five years in length, one in Mechanical and Electrical Engineering and the other in Civil Engineering. These courses are alike in character and the same in content to the end of the third year.

For the satisfactory completion of the first four years of either course, the degree, Bachelor of Science, will be given by the College of Liberal Arts.

The degree, Electrical Engineer, will be given by the College of Engineering at the end of the five-year course in Mechanical and Electrical Engineering, and the degree, Civil Engineer, at the end of the five-year course in Civil Engineering.

COURSE IN MECHANICAL AND ELECTRICAL ENGINEERING

	Semester Hours	
Freshman Year	First Semester	Second Semester
English A1	3	3
French A	3	3
Physics A1	4	4
Mathematics A3	5	5
Mechanical Drawing, Engineering A1, or Shop Work, Engineering A2	2	..
Mechanical Drawing, Engineering A1, or Shop Work, Engineering A2	..	2
Summer Work	..	2
Sophomore Year		
German A	3	3
Physics B1	3	3
Calculus, Mathematics B1	3	3
Chemistry A	4	4
Surveying, Engineering B2	3	3
Shop Work, Engineering B1	1	1
Summer Surveying, Engineering B3	..	6

	Semester Hours First Semester	Second Semester
Junior Year		
Economics A	3	3
Physics C1	3	3
Chemistry B1	4	..
*Chemistry B2	..	4
Geology A1	4	..
*Geology A3 or B9	..	4
Descriptive Geometry, Kinematics, and Graphical Statics, Engineering C1	3	3
Summer Work	..	2
Senior Year		
English B1	2	2
Structural Mechanics, Engineering D3	3	3
Calculus, Mathematics C1	3	3
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Electrical Engineering, Engineering D6	3	3
Elective	3	3
Summer Work	..	2
Fifth Year		
Hydraulic Engineering, Engineering E4	3	3
Thermodynamics, Engineering E1	4	..
The Public Relations of Engineers, Engineering E2	..	2
Thesis, Engineering E7	2	4
Engines, Engineering E3	3	3
Advanced Electrical Engineering, Engineering E5	3	..
Electric Power Plant Engineering, Engineering E6	..	3
Elective	2	2

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*The student may omit either Chemistry B2 or the second semester of Geology.

COURSE IN CIVIL ENGINEERING

The first three years of this course are the same as those in the course in Mechanical and Electrical Engineering shown above.

	Semester Hours First Semester	Semester Hours Second Semester
Senior Year		
English B1	2	2
Structural Mechanics, Engineering D3	3	3
Calculus, Mathematics C1	3	3
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Electrical Machinery, Engineering D5	3	..
Heat Engines, Engineering D4	..	3
Elective	3	3
Summer Work	..	2
Fifth Year		
Hydraulic Engineering, Engineering E4	3	3
Railroad Engineering, Engineering E10	4	..
The Public Relations of Engineers, Engineering E2	..	2
Thesis, Engineering E7	2	4
Structures, Engineering E9	5	..
Bridges, Engineering E8	..	5
Elective	3	3

Each course may be taken precisely as shown above by a student who enters the College with the standard preparation which includes English three units, Algebra one and one-half units, Plane Geometry one unit, Solid Geometry one-half unit, French two units, and German two units. If however the student enters College deficient in any of the subjects enumerated in the preceding sentence and the deficiency is not counterbalanced by excess elsewhere in his preparation of the character indicated later in this paragraph, it will

be impossible for him to complete either engineering course in five years without securing more than an average of seventeen semester hours of credit in each semester. Only an exceptionally strong student may expect to secure more than seventeen hours of credit per semester. Certain subjects when accepted for entrance credit constitute an excess in the sense that they relieve the student offering them of some college work which would otherwise be required of him in the engineering courses. These are College Algebra, Plane Trigonometry, Chemistry, a second unit of Mechanical Drawing, a second unit of Manual Training, and such preparation in foreign language as will leave the student less than twelve semester hours of foreign language to be taken in college in order to meet the requirements for the degree of Bachelor of Science which are shown in the Catalog of the University. As an example it may be stated that a student who presents three units of German or Latin, and two of French, is required to take in college French A only, six semester hours, instead of both French A and German A as listed above, twelve semester hours.

For recitations or lectures one semester hour of credit is given for one period, fifty minutes, each week, during one semester. For shop work, drafting or laboratory work, one semester hour of credit is given for one three-hour period each week during one semester.

REQUIRED SUMMER WORK

During each of the three summers following the first, third and fourth years the student is required to do practical work for at least six weeks, of such a character as to furnish experience of value to him as a prospective engineer. The credit assigned to six weeks of such approved work is two semester hours.

Under this requirement, students have acted as rodmen on city surveys, rodmen on the United States Lake Survey, workers in the tool room of a factory, helpers in the installation of heavy machinery in a new steam-electric power plant, foremen of gangs of laborers, helpers in the wiring of telephone switchboards, assistants in cement testing, computers for the Carnegie Institution, inspectors with a

company engaged in electric lighting and power distribution, and have worked on milling and machine work, figuring estimates, making tracings, and on land and topographical surveys.

During the summer following the second year the student is required to do field work in surveying for six weeks immediately following commencement, Engineering B3, credit six semester hours. This is a regular college course under the direction of college professors.

DESCRIPTION OF COURSES

The following paragraphs give more specific information in regard to the separate courses enumerated above as together constituting the courses in Mechanical and Electrical Engineering and in Civil Engineering.

English A1. Composition and Rhetoric; Brief Survey of English Literature—Required of all students in their first year. Three semester hours throughout the year.

English A2. Composition and Rhetoric—Required of students whose preparation is found to be insufficient for English A1. The work of the first semester is continued two hours a week in the second semester and attendance is required until the student's work is brought consistently up to a satisfactory standard.

French A. Modern French—Fraser and Squair's Grammar, Part II. Composition, conversation, and dictation. Reading: Schintz's Selections from Maupassant; Daudet's Tartarin de Tarascon; Augier's Le Gendre de M. Poirier; Pailleron's Le Monde où l'on s'ennuie; Hugo's Quatre-Vingt Treize and Hernani; Balzac's Eugénie Grandet; Canfield's French Lyrics. Three semester hours throughout the year. Open to students who present two units of French for entrance. If the student has presented no French for entrance he must take French AA, five semester hours throughout one year, in college before being admitted to French A, or if he has presented one unit of French for entrance, he must ordinarily take French AB, three semester hours throughout one year, in college before being admitted to French A.

German A. Intermediate German—Modern prose writers, classic drama and lyrics. Three semester hours throughout the year. Open to students who present two units of German for entrance. If the student has presented no German for entrance he must take German AA, five semester hours throughout one year, in college before being admitted to German A, or if he has presented one unit of German for entrance he must ordinarily take German AB, three semester hours throughout one year, in college before being admitted to German A.

If the student has offered for entrance two units of French and two of German, he is advised to take French A in the first year and German A in the second year, but the order may be reversed. If other language units than those named in the preceding sentence have been offered for entrance, the student is required to take such language courses as will satisfy the language requirement for the degree of Bachelor of Science. These are not necessarily the courses French A and German A. For example, if a student has presented two or three units of Latin or of Greek for entrance he may be released, both as to entrance credits and as to college work, from a part of French or German. For complete information on this point, consult the statement of prescribed courses for the degree of Bachelor of Science, in the University catalog.

Mathematics A3. Plane Trigonometry, Algebra and Analytical Geometry—This is a course in which Plane Trigonometry, Algebra and Analytical Geometry are given together in one continuous course. Open to students who have presented one and a half units of Algebra for admission. Five semester hours throughout the year.

If a student has presented College Algebra or Plane Trigonometry for entrance, instead of taking Mathematics A3 in the freshman year, he is required to take three semester hours in each of two semesters in courses so arranged that with the work offered for entrance they will be equivalent to Mathematics A3.

Mathematics B1. Differential and Integral Calculus—A first course in Calculus, including its simpler applications. Open to students who have completed Mathematics A3, or an equivalent. Three semester hours throughout the year.

Mathematics C1. Advanced Calculus—Infinite series; Taylor's theorem; partial differentiation; differential geometry; definite integrals over curves, surfaces and volumes; the Eulerian functions; differential equations. Open to students who have completed Mathematics B1. Three semester hours throughout the year.

Physics A1. General Physics—First semester—General properties of matter, wave-motion, sound, heat. Second semester—Electricity, magnetism, light. An introductory course requiring no mathematics beyond the requirements for entrance to college, intended to acquaint the student with the elementary facts, the method, and the general principles of physical science. Text-book: Crew's General Physics. Three lectures and one laboratory exercise each week. Open to all students. Four semester hours throughout the year.

Physics B1. Mechanics—An elementary experimental study of forces, moments of force, moments of inertia, elasticity, hydromechanics, an introduction to advanced Physics and Engineering. This is a course in pure Dynamics, and serves as an introduction to Applied Mechanics. Two lectures and one laboratory exercise each week. The laboratory work is guided by specially prepared instructions. Open to students who have completed Physics A1, or its equivalent, and who have completed or are taking Mathematics B1. Three semester hours throughout the year.

Physics C1. Electricity and Magnetism—The more general laws of electricity and magnetism are discussed; the practical equations employed in the laboratory are derived and discussed. The laboratory work includes the measurement by one or more methods of current, resistance, electromotive force, temperature-coefficients, capacity; a study of the magnetic properties of iron and steel, thermoelectric effects, the use of the electrometer, the Carey Foster bridge, potentiometer, copper coulometer, etc. Open to students who have completed Mathematics B1 and who have completed or are taking Physics

B1. Two lectures and one laboratory exercise each week. Three semester hours throughout the year.

Chemistry A. General Chemistry, Elementary—Text and laboratory work. Open to all students. Four semester hours throughout the year.

Chemistry AB. General Chemistry—To supplement the high school course, making the total equivalent to Chemistry A. Open to students who present one unit of chemistry for admission. Four semester hours for one semester, to be taken in either semester.

Chemistry B1. Qualitative Analysis—Analysis of simple mixtures accompanied by lectures and quizzes. Recitations and laboratory work. Open to students who have completed Chemistry A or an equivalent. Four semester hours for one semester, to be taken in either semester.

Chemistry B2. Organic Chemistry—Lectures and quizzes on the hydrocarbons and their derivatives. Laboratory preparation and study of typical organic compounds. Recitations and laboratory work. Open to students who have completed Chemistry A and B1 or an equivalent. Five semester hours for one semester, to be taken in either semester. One semester hour is credited as an elective.

Geology A1. General Geology—A general introduction to Geology. Lectures, recitations and laboratory work. Open to Sophomores, Juniors and Seniors. Four semester hours for one semester, to be taken in either semester.

Geology A3. Mineralogy—Crystallography, descriptive mineralogy, and determinative mineralogy of the common ores and rock forming minerals. Open to students who have completed in college or in high school a year course in Chemistry. Four semester hours for one semester, to be taken in either semester.

Geology B5. Metallurgy—Fuels, refractory and cementing materials, metallurgy of iron and steel. Open to those students of Engineering who have completed Chemistry A. Two semester hours in the first semester only.

Geology B9. Historical Geology—A history of the earth, with special reference to the evolution of the North American Continent. Open to students who have completed Geology A1. Four semester hours in the second semester only.

Economics A. The Elements of Economics—First semester—An examination of the fundamental principles of economics. Second semester—Application of these principles to practical problems. Open to Sophomores, Juniors and Seniors. Three semester hours throughout the year.

English B1. Types of English Literature; Composition—Lectures, recitations, written reports and themes, and reading. Open to students who have completed the required English of the first year. Two semester hours throughout the year.

Electives—Six semester hours of electives are provided for in the senior year of the Mechanical and Electrical Engineering course and four in the fifth year. In the fourth and fifth years of the Civil Engineering course a total of twelve hours of electives are required. These electives are limited to courses given in the College of Liberal Arts, the choice to be approved by the Director.

Engineering A1. Mechanical Drawing—An elementary course in the technique of mechanical drawing, requiring no previous knowledge of drawing. Freehand lettering, exercise drawing, freehand sketching, shop drawing in pencil, tracing in ink on tracing cloth. Open to all students. Two drawing periods each week. Two semester hours for one semester, to be taken in either semester.

Engineering A2. Freshman Shop Work—A series of elementary practical exercises in the shop, upon a wide variety of subjects, the object being to bring out the principles involved, to acquaint the student with a considerable range of mechanical experience, and to cultivate habits both of logical thinking and of accurate work. The exercises involve some wood turning, pattern making, filing, scraping, sawing, punching, riveting, brazing, metal turning, shaping, planing, milling, grinding, etc. These exercises are guided by assigned readings, blue-printed instructions and by lectures on mechanical princi-

ples and processes, with occasional written work. Open to all students. Two shop periods each week. Two semester hours for one semester, to be taken in either semester.

Ordinarily it is expected that an engineering student will take Engineering A1 in one semester and Engineering A2 in the other semester of his freshman year.

Engineering B1. Sophomore Shop Work—This is a more intensive course than Engineering A2, limited mainly to pattern work, machine work, and tool making. The work is upon problems rather than exercises, and in them the student is given an opportunity to show his ingenuity and his grasp of the subject; while his work is directed in a general way, he is not given detailed instructions. The objects made are generally parts of some machine; this emphasizes the need for accuracy and gives a practical turn and interest to the subject. The work naturally introduces the student to a somewhat advanced knowledge of machines and processes. Open to students who have completed Engineering A2. One shop period each week. One semester hour throughout the year.

Engineering B2. Surveying—The use of chains, tapes, compass, level, transit, and plane table; methods of land, topographic and hydrographic surveying, including stream measurement, mine surveying and city surveying. Text-book: Theory and Practice of Surveying, by J. B. Johnson and L. S. Smith. Open to students who have completed Engineering A1 and Mathematics A3. Two recitations and one field period each week. Three semester hours throughout the year.

Engineering B3. Summer Surveying—Applications under actual field conditions of the theory taught in Engineering B2. The outcome of the work will be a map of the region covered by the survey and much allied information. A new area will be covered each year, ordinarily adjacent to the area surveyed in the preceding year. Six weeks immediately following commencement. Open to students who have completed Engineering B2. Credit six semester hours.

Engineering C1. Descriptive Geometry, Kinematics and Graphical Statics—The course is divided into three equal parts: (1) Descriptive Geometry; first principles; point, line and plane. Text-book: Essentials of Descriptive Geometry, by Phillips and Millar. (2) Kinematics; elementary propositions; communication of motion by rolling and sliding contact, by link work, by wrapping connectors. Text-book: Elementary Mechanism, by Stahl and Woods. (3) Graphical Statics; general principles; concurrent and non-concurrent forces; moments; roof trusses; loads; reactions; stresses; wind load stresses; cantilever and unsymmetrical trusses. Text: Graphic Statics, by Malcolm. Open to students who have completed Engineering A1 and Mathematics A3. One recitation period and two drawing periods each week. Three semester hours throughout the year.

Engineering D1. Contracts and Specifications—The course deals with contracts and specifications as applied to engineering only. Recitations and lectures. Text-book: The Law of Contracts, by John C. Wait. Open to students who have sixty hours of credit. Two semester hours in the second semester only.

Engineering D2. Journal Meeting—The time is spent in reading and reviewing current engineering literature, the object being to acquaint the student with this fund of information, to show him the necessity of judicious selection from the great mass of such current literature, to indicate methods of selection, and to cultivate a habit of accurate reading. Open to students who have taken or who are taking Engineering D3, D4, D5, or D6. One laboratory period each week. One semester hour throughout the year.

Engineering D3. Structural Mechanics—The text-book work is upon the application of mechanics to the elementary parts of structures, taking up properties of materials, testing materials, elementary theory of elasticity, stresses and strains of beams, columns, shafts, tubes, curved bars, springs and bodies in rapid rotation; stability of piles and retaining walls; elementary theory of reinforced concrete. The laboratory work relates partly to standard methods of testing

materials such as steel and cement, but it is largely involved in an effort to bring to the clear comprehension of the student the various relations deduced in the text-book work upon the subject. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering D4. Heat Engines—A course in prime movers and general power plant equipment. Elementary thermodynamics. Construction and operation of steam engines, turbines and gas engines. Engine testing. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours in the second semester only.

Engineering D5. Electrical Machinery—A course in Direct and Alternating Current Machines. Special emphasis is placed upon the study of the fundamental principles involved and upon the application of these principles in practise. Open to students who have completed Mathematics B1 and Physics C1. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering D6. Electrical Engineering—First semester—A general study of the fundamental principles of Electrical Engineering and their applications to direct current machinery. A selected series of problems are assigned to illustrate quantitatively the principles involved. Second semester—A general study of the fundamental principles of single and polyphase alternating currents, with special reference to analytic and graphic methods of treatment. Elementary analysis of alternating current machinery. Open to students who have completed Physics C1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E1. Thermodynamics—The course consists of text-book work first upon the general theory of thermodynamics, and later upon its application to heat engines, taking up properties of gases, flow of gases, thermodynamics of air engines, internal combustion engines and air compressors, properties of steam and other

vapors, thermodynamics of steam engines and steam turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Four semester hours in the first semester only.

Engineering E2. The Public Relations of Engineers—A course of lectures and reading dealing with the relations of a practising engineer to other men. It will deal in part with biographies of engineers, the history of engineering, the purpose of organization and the conservation of natural resources. Open to students who have taken or who are taking Engineering E1, E3, E4, E5, E6, E8 or E9. Two semester hours in the second semester only.

Engineering E3. Engines—A detailed study of the steam engine, steam turbine, boiler plant equipment, gas engines and producer gas plants. Open to students who have taken or who are taking Engineering E1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E4. Hydraulic Engineering—The theory and application of the principles of hydrostatics and hydrodynamics; measurements of flow by pressure gauges, meters, Pitot tubes and weirs; path, energy and impulse of jets; flow through orifices, tubes and pipes with loss of energy or head due to contractions, expansions and nozzles; derivation and application of formulæ for discharge, velocity and pressure; work derived from moving vanes as in water wheels and turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E5. Advanced Electrical Engineering—Advanced analysis by the analytic and graphic methods of treatment of continuous and alternating current machinery, of general alternating current and of transient phenomena. Lectures, assigned reading, recitations and laboratory work. Open to students who have completed Engineering D6. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering E6. Electric Power Plant Engineering—A study of special problems in connection with the generation and transmission of electrical energy in large systems and in high potential systems. Emphasis is laid upon the proper relation of parts to form a complete plant. Lectures, assigned reading, recitations and laboratory work. Open to students who have completed Engineering E5. Two recitations and one laboratory period each week. Three semester hours in the second semester only.

Engineering E7. Thesis—Open to students in the last year in the Engineering course. Two semester hours in the first and four in the second semester.

Engineering E8. Bridges—A general course on the theory and design of bridges, taking up stone arches, reinforced concrete arches, culverts and steel bridges of many types. Open to students who have completed Engineering D3. Three recitations and two drawing periods each week. Five semester hours in the second semester only.

Engineering E9. Structures—A general course on the theory and design of foundations, retaining walls, tall chimneys, masonry dams and building construction. Open to students who have completed Engineering D3. Three recitations and two drawing periods each week. Five semester hours in the first semester only.

Engineering E10. Railroad Engineering—The use of the transit, chain, level, etc., in laying out simple, compound and vertical curves; methods of reconnaissance, preliminary and location surveys; turnouts, switches and wye tracks; profile and cross section surveys, and computation of earthwork; haul and mass diagrams; maps and drawings; the use of topographic surveys in location; drainage, waterways and bridge staking. Economic theory of railway location, construction, extension and maintenance. Field work consists of laying out a short line and of the practical application of methods of staking, computation and mapping given above. Open to students who have completed Engineering B2 and Mathematics B1. Three recitations and one field period each week. Four semester hours in the first semester only.

General Regulations

REGISTRATION

Every student is required to register in person at the office of the Registrar, College of Engineering, before entering upon college work, on the registration days specified in the calendar. Returning students who register after the close of this period are subject to a fee of two dollars.

On the registration days of the first semester the student must register for the work of the whole year. Changes may be made only with the consent of the Director. A course dropped without consent is regarded as a failure and is so recorded.

At the time of registration the student obtains from the Registrar his bill for tuition and fees for the semester. This should be paid at the Business Manager's Office within one week.

CLASSIFICATION

Students in the College of Engineering are grouped in five classes according to their credits in the office of the Registrar. The basis for their classification is as follows:

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first four years, and who have satisfied all entrance requirements, are classed as fifth year students.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first three years, and who have satisfied all entrance requirements, are classed as seniors.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first two years, and who have satisfied all entrance requirements, are classed as juniors.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first year, and

who have satisfied all entrance requirements, are classed as sophomores.

All other regular students are classed as freshmen, without regard to the date of admission.

GRADES OF SCHOLARSHIP, EXAMINATIONS, AND ATTENDANCE

In other matters of student regulation, such as examinations, grades of scholarship, class and chapel attendance, and physical training, the students of the College of Engineering are governed by the regulations stated in the general University Catalog and in the Undergraduate's Manual.

FEES AND EXPENSES

Matriculation Fee, paid by each student when he first enters the University	$ 5.00
Tuition and Incidentals, per year, except for Fifth Year students	150.00
Tuition and Incidentals, per year, for Fifth Year students	40.00

Tuition and Incidentals are payable one-half at the beginning of the first semester, one-half at the beginning of the second.

Laboratory Fees.

Engineering A1	$ 3.00 a semester
Engineering A2	8.00 a semester
Engineering B1	4.00 a semester
Engineering B2 or D3	5.00 a semester
Engineering C1, D4, D5, D6, E3, E4, E5, E6, E8, E9 or E10	3.00 a semester
Student Enterprise Fee	2.50 a semester
Fee for summer surveying course, Engineering B3	15.00
Diploma Fee	10.00

The average cost to a student of engineering for the first four years, of all tuition and fees, as enumerated above, is about $172 per year.

The laboratory fees for engineering courses are intended to cover ordinary depreciation of apparatus and the use of materials. The student is held responsible for any damage due to his negligence.

Laboratory fees are not refunded if the student continues in a course as long as two weeks.

The tuition fees will not be refunded except in case of sickness. If a student withdraws before the middle of the semester, on account of serious illness, one-half of his tuition fee will be refunded, on his obtaining from the Director a statement of honorable standing, and from a physician a certificate that his health will not permit him to remain in attendance. The student will also be required to return his receipted bill for tuition.

Reduced rates of tuition are given to sons of clergymen who are actively pursuing the work of the ministry ($53.00 per semester) and to holders of old-time perpetual or transferable scholarships, for incidentals ($52.50 per semester).

The remaining necessary expenses of a student, namely, board, room, laundry, text-books and stationery, for nine months, vary from $280 to $460, the average being about $360 in normal times. In 1917-1918 these expenses will necessarily be higher on account of war conditions.

DORMITORIES

A new system of thirteen dormitories for men students is now in use. Nine of these buildings are designed for fraternities, whose alumni have contributed toward their cost, and the remaining four are open for rental by any of the men students of the University.

The buildings are architecturally beautiful and are meant to be models in comfort and sanitation. They are fireproof, lighted by electricity, and heated by steam. On the first floor of each building is a large enclosed porch, and a well equipped club room with an open fire-place, rugs, tables, and lounging chairs. There are also a few rooms for individual students on this floor. The second and third floors are made up entirely of single rooms.

Each student's private room is furnished with a single bed, mattress and pillow, a chiffonier, a combined study table and bookcase, two chairs, a rug, and window shades. The student furnishes his own bedding and towels, but the University takes charge of the laundering of these. In the interest of economy, electric lighting is not included in the general charge, but is apportioned pro rata monthly to the occupants of the building.

In the men's dormitories room rent is payable at the beginning of each semester and the charge to each student for the use of a furnished single room, including care, heat and water, varies from ninety to one hundred and ten dollars a year. The rental for private rooms on the first floor is somewhat higher.

The Registrar of the College of Liberal Arts is the renting officer of the dormitories; and men of the College of Engineering not living at their homes or in fraternity houses are required to live in the dormitories unless no rooms are available, or they obtain through the Registrar written permission to room elsewhere. Blank application forms for such permission will be furnished on request.

A chart showing the location and rental prices of rooms may be had from the Registrar upon application.

SCHOLARSHIPS

A few scholarships, worth $120 each, are awarded annually (five in 1917-1918) to select members of the incoming class, upon applications endorsed by the principal and faculty of the secondary school from which the applicant graduates. The applicant must meet the full entrance requirements and must present certificates from the teachers in his secondary school for excellence of character and scholarship, for physical vigor, manliness and promise of usefulness as a citizen. The award is made at the University by a committee of the College faculty.

A few scholarships, worth $120 each, are awarded annually (four in 1917-1918) to select members of the upper classes.

The upper class scholarship known as the *Swift Scholarship* has been given by Mrs. Gustavus F. Swift to members of the upper classes.

OPPORTUNITIES FOR SELF-HELP

Some students in Evanston have been able, while in college, to earn the cost of their living in full, and every year a large percentage earn a considerable portion of their expenses, and at the same time maintain a high standing in their studies. It is never advisable, however, for a student to undertake more work of this kind than is necessary for his personal support, and if the amount is excessive he should plan to give more than the normal five years to his college course.

The General Secretary of the Young Men's Christian Association maintains a bureau to assist students in finding employment. The positions most frequently open to young men are those as waiters at boarding places or as attendants in private houses in the care of gardens or furnaces. While the aggregate of the annual earnings of students is a large sum, the number of positions open is limited and no assurances can be given that employment will be found. Only the most faithful and self-reliant students should undertake self-support, and in no case should a student come to Evanston without sufficient means to meet expenses for at least a half-year.

RELIGIOUS AND SOCIAL LIFE OF STUDENTS

The charter of the University provides that "no particular religious faith shall be required of those who become students of this institution." Students are expected to attend public worship on Sunday in the church of their choice. Chapel service is held at ten o'clock on each week day, except Saturday, throughout the college year. Attendance upon at least two-fifths of these services is required. Under the direction of the Young Men's Christian Association religious meetings are held each week.

In athletics, in social life and in the use of the buildings, there is no separation of the students of Engineering from the students of Liberal Arts. Engineering students go to the various buildings of

the College of Liberal Arts for recitations in other than strictly engineering subjects. They share in the use of the University Library. They have free access to the new gymnasium, the largest in the United States. Their social life is mingled with that of the Liberal Arts students in one university group.

The Engineering Society, composed of students of engineering and members of the engineering faculty, provides numerous addresses by prominent engineers and organizes inspection trips to points of engineering interest. The members also furnish many additional programs so that the society holds a meeting nearly every week.

An Engineering Assembly, attended by all students of engineering and by the engineering faculty, occurs eight times during each year. The general purpose of these assemblies is to develop a group consciousness in the students of engineering and to bring forward matters of especial interest to the group.

Some Advantages of the College of Engineering at Northwestern University

It offers a thorough professional course rather than a purely practical course. It places the emphasis on the fundamentals which are common to all branches of engineering. It trains its graduates for unlimited growth as engineers and for possible leadership.

The engineering courses, five years in length, are so arranged as to give each man his general broad training at the same time that he pursues his engineering studies. The engineering students are closely associated with the larger group of Liberal Arts students, of which they, in fact, form a part.

In the purely engineering part of the course, the proportion of professors to students is much larger than is customary and each student, therefore, receives an unusual amount of attention.

There is more engineering in progress within fifty miles of the loop district of Chicago than in any area of the same size anywhere in the United States with the possible exception of New York City.

The students of this College thus have an unsurpassed opportunity to keep in touch with engineering practise and to meet engineers.

The College of Engineering is a young organization in excellent condition to take advantage of the experience of other colleges in training engineers.

It is provided with ample shop and laboratory equipment, selected with unusual care and deliberation, purely for teaching purposes and housed in an excellent building.

Inquiries for further information, requests for the catalog of the University, for scholarship application blanks, and for blank forms of certificates from secondary schools may be addressed to John F. Hayford, Director, College of Engineering, Northwestern University, Evanston, Illinois.

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Northwestern University

Evanston — Chicago

¶ THE COLLEGE OF LIBERAL ARTS, in Evanston, offers well organized courses for general education, with special preparation for the professions and for other pursuits requiring broad training.

¶ THE GRADUATE SCHOOL, in Evanston, extends non-professional training and research beyond the College curriculum, with courses leading to advanced degrees.

¶ THE MEDICAL SCHOOL, in Chicago, is one of the best equipped in the United States and its reputation for efficiency is well-established. Numerous hospitals in close proximity are open to students. Clinical material is abundant.

¶ THE LAW SCHOOL, in Chicago, offers unexcelled library and research facilities. Its courses leading to degrees prepare for practice in any state.

¶ THE COLLEGE OF ENGINEERING, on the campus in Evanston, offers a five-year course of technical training in a University environment, leading to the degrees of Bachelor of Science and Civil Engineer or Electrical Engineer.

¶ THE DENTAL SCHOOL, in Chicago, is recognized as one of the leading schools for dental training and investigation. Its clinical facilities are unsurpassed.

¶ THE SCHOOL OF MUSIC in three well-equipped buildings offers exceptional advantages for the thorough study of music, professional or otherwise. It is located in Evanston.

¶ THE SCHOOL OF COMMERCE, in Chicago and Evanston, offers professional and scientific education for business with emphasis on the training of business executives. Day and evening work, laboratory courses, and business research.

¶ THE SCHOOL OF ORATORY, in Evanston, is unique in having university relations. It offers a well arranged course in interpretative literature, and a special course in Physical Education for teachers.

For information regarding any School of the University, address the President's Office, Northwestern University Building, Chicago, Illinois.

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Northwestern University Bulletin

COLLEGE *of* ENGINEERING ANNOUNCEMENTS 1918-1919

Published Weekly by Northwestern University
Northwestern University Building
CHICAGO

Vol. XVIII. No. 28 March 16, 1918

NORTHWESTERN UNIVERSITY

Special Advantages of the College of Engineering

A thorough professional course rather than a purely practical one, with five years of broad training.

Small classes in which each student receives an unusual amount of individual attention.

A splendid building designed for the purpose, and up-to-date apparatus carefully selected to promote effective teaching.

Accessibility to great engineering projects, with unsurpassed opportunities to meet engineers and keep in touch with engineering practice.

A young thriving college in an old university.

Northwestern University Bulletin

COLLEGE *of* ENGINEERING ANNOUNCEMENTS

1918-1919

Published by the University
March, 1918

SWIFT HALL OF ENGINEERING

Swift Hall of Engineering, the gift of Mrs. Gustavus F. Swift and her son, Edward F. Swift, was dedicated in 1909. The building measures fifty-eight by one hundred and twenty-six feet; the exterior is of Bedford limestone, and presents architectural lines that are of the best; the interior is a model of appropriate decoration, convenience, safety and strength; it has concrete floors and stairways throughout. It presents five working stories, all well lighted and of good height, and the large rooms at the ends of the building are free from columns. From the beginning, it was especially planned as the home of the College of Engineering. The building is in a delightful location overlooking Lake Michigan.

Faculty

THOMAS FRANKLIN HOLGATE, Ph.D., LL.D.
President *ad interim*

JOHN FILLMORE HAYFORD, C.E.
Director

OLIN HANSON BASQUIN, Ph.D.
Professor of Applied Mechanics

WILLIAM CHARLES BAUER, B.S., Sc.D.
Professor of Electrical Engineering

HERBERT SHAW PHILBRICK, B.A., B.S.
Professor of Mechanical Engineering

WILLIAM HENRY BURGER, B.S.
Professor of Civil Engineering

MILBY ROY HAMMER, B.S.
Associate Professor of Drawing

JAMES TAFT HATFIELD, Ph.D.
Professor of German Language and Literature

HENRY CREW, Ph.D.
Professor of Physics

*EDOUARD PAUL BAILLOT, L.H.D.
Professor of Romance Languages

ULYSSES SHERMAN GRANT, Ph.D.
Professor of Geology

ARTHUR CHARLES LEWIS BROWN, Ph.D.
Professor of English

---

*On leave of absence, for National service.

FREDERICK SHIPP DEIBLER, Ph.D.
Professor of Economics

DAVID RAYMOND CURTISS, Ph.D.
Professor of Mathematics

WALTER LICHTENSTEIN, Ph.D.
Librarian

WILLIAM FRANK BRYAN, Ph.D.
Associate Professor of English

MURRAY ARNOLD HINES, Ph.D.
Assistant Professor of Chemistry

ELTON JAMES MOULTON, Ph.D.
Assistant Professor of Mathematics

KEITH KUENZI SMITH, Ph.D.
Assistant Professor of Physics

*GEORGE VEST McCAULEY, Ph.D.
Assistant Professor of Physics

CLARENCE STEPHEN MARSH, B.A.
Registrar

VIVIEN K. RATHBUN
Assistant Registrar

ANDREWS ALLEN, C.E.
Lecturer on Contracts and Specifications

ELMER MARTIN LIESSMANN, LL.B.
Lecturer on Contracts and Specifications

ARTHUR WALD
Shop Assistant

---

*On leave of absence, for National service.

Calendar

1918-1919

1918		
Sept. 23	Mon.	Academic year 1918-1919 begins; examinations for admission; first day of registration
Sept. 25	Wed.	Second examinations; last day of registration
Sept. 26	Thu.	Class work begins
Nov. 28	Thu.	Thanksgiving Recess, to December 1, inclusive
Dec. 21	Sat.	Christmas Recess, to January 6, Monday, inclusive
1919		
Jan. 7	Tue.	Class work resumed
Jan. 27	Mon.	Mid-year examinations begin
Feb. 5	Wed.	Last day of registration for second semester
Feb. 6	Thu.	Second semester begins; class work resumed
Feb. 8	Sat.	Second examinations
Apr. 17	Thu.	Easter Recess, to April 22, Tuesday, inclusive
Apr. 22	Tue.	Second examinations
May 26	Mon.	Regular examinations begin
June 11	Wed.	SIXTY-FIRST ANNUAL COMMENCEMENT
June 12	Thu.	Beginning of summer surveying
July 23	Wed.	End of summer surveying

Historical Note

THE charter of Northwestern University was signed by the Governor of Illinois on January 28, 1851. The corporation consists of forty-two trustees. An amendment to the charter provides that no intoxicating liquors shall be sold within four miles of the University.

The trustees selected as the seat of the University a tract of land on the shore of Lake Michigan, twelve miles north from the heart of Chicago. Here in 1855 the first University building was erected and about its location has grown up the City of Evanston. Here are the College of Liberal Arts, the College of Engineering, the School of Music, and the School of Oratory. The schools of Medicine, Law, Dentistry and Commerce are located in the City of Chicago.

The College of Liberal Arts, the oldest department of the University, was opened to students in the fall of 1855. From its small beginning it has grown, not by rapid expansion or by large benefactions, but by steady gains along conservative lines—each of its sixty years adding some improvements to its physical and educational equipment. The work of the College of Liberal Arts is mainly directed toward furnishing opportunities for a liberal culture or general education. The regulations affecting the choice of studies are such that the student may elect a large part of his work along lines in which he is especially interested.

In recent years a demand for instruction in engineering gradually made itself felt. A gift for the erection of an engineering building at Evanston and for its endowment led the Trustees of the University to take action in June, 1907, resulting in the establishing of a College of Engineering. This gift came from Mrs. Gustavus F.

Swift and her son, Edward F. Swift. The building, known as the Swift Hall of Engineering, was dedicated in May, 1909. It is now occupied by the College of Engineering. The Department of Mathematics of the College of Liberal Arts also has offices and recitation rooms in the building.

In 1917-1918, the College of Engineering had a total registration of eighty-six students.

STATEMENT OF PURPOSE

The purpose of the College of Engineering of Northwestern University is to furnish to each student a thorough training for the profession of engineering, combined with a general training of the man. The College aims to train engineers for the greatest average effectiveness in a lifetime rather than for the greatest effectiveness in the first year after graduation. It aims to develop a capacity for unlimited growth. Hence strong emphasis is laid on those studies which tend to develop the man as well as on those which furnish training in engineering.

In keeping with these ideals, the courses in engineering introduce an unusual number of those non-technical studies that serve to give a general education and to develop the thinking power of the students. Unusual stress is laid upon Mathematics, upon Physics and other sciences fundamental to engineering and upon the principles which are broadly applicable to all engineering. The courses are five years in length, because past experience among colleges of engineering shows that four years is too short a time for the thorough professional training contemplated. At the end of four years the student of engineering will have secured as thorough a general training as one who comes to Northwestern University for general training alone. In recognition of that fact, he will be given the degree of Bachelor of Science by the College of Liberal Arts. During the fifth year the general training of the student is continued and he completes his professional course in engineering.

The motto of the College is "Culture for Usefulness." This motto calls for an effort to obtain for the student the broadest

culture attainable in five years in order to equip him, as a man and as an engineer, for the greatest possible usefulness in the world in the united struggle of man for progress.

Requirements for Admission

Candidates for admission without entrance conditions must qualify by examination or by certificate on fifteen units of High School work. The unit is a course of study requiring a daily recitation on a prepared topic for a full school year, and covering in the various subjects the work defined in the University Catalog.

English, three units; Algebra, one and a half units; and Plane Geometry, one unit, are required of all candidates. A choice is allowed in the selection of other subjects, but the choice must include either four units of foreign language or two units of foreign language plus two units chosen from the following group: College Algebra one-half unit, Plane Trigonometry one-half unit, Solid Geometry one-half unit, Physics one unit, Chemistry one unit, Manual Training one or two units, and Mechanical Drawing one or two units. The choice of foreign language is limited to Latin, Greek, French and German and a certain maximum number of units in each as indicated in the table which follows. A single unit of any language will be accepted to meet the specific foreign language requirement only when accompanied by at least three units of some other language or two units each of two others. The remaining five and one-half units required to make an aggregate of fifteen units may include any subjects commonly appearing as a part of a high school course, provided that no subject is presented for less than a half unit of credit. Vocal music and physical training are not recognized for credit.

The following table indicates the subjects commonly presented for admission credit:

Latin	2, 3 or 4 units
Greek	2 or 3 units
German	2 or 3 units
French	2 or 3 units
Spanish	2 units
College Algebra	½ unit
Plane Trigonometry	½ unit
Solid Geometry	½ unit
Physiography	1 unit
Physics	1 unit
Botany	1 unit
Zoology	1 unit
Chemistry	1 unit
Ancient History	1 unit
Mediæval and Modern History	1 unit
English History	1 unit
American History (or with Civil Government)	1 unit
Civil Government	½ unit
Political Economy	½ unit
Commercial Geography	½ unit
Commercial Law	½ unit
Physiology	½ unit
Mechanical Drawing	1 or 2 units
Manual Training	1 or 2 units

One unit of entrance credit in Mechanical Drawing may be given for twelve hours work per week for a full school year, or an equivalent amount of time, provided the work is of an acceptable character. A second unit of credit may be given in Mechanical Drawing only in case the course in drawing taken in school covers the full equivalent of the course Engineering A1 of the College of Engineering.

One unit of entrance credit in Manual Training may be given for twelve hours work per week for a full school year, or an equivalent amount of time, provided the work is of an acceptable character. A second unit of credit may be given in Manual Training only in case the course in Manual Training taken in school covers the full equivalent of the course Engineering A2 of the College of Engineering.

For a statement in detail of the definitions of other entrance units consult the Catalog of the University.

Each student in engineering who has not presented Solid Geometry for entrance will be required to take Solid Geometry, three hours for one semester, in the first year. As this will be an extra task,

making it difficult for the student to keep up with his class, each candidate is advised to present this subject for entrance if possible.

So, too, there are various other ways in which a student in meeting the entrance requirements may by his selection of the subjects presented either lighten his later college work, or may so handicap himself as to make it difficult to secure an engineering degree in five years. For a general suggestion on this point, consult page 14.

A candidate may be admitted to the College of Engineering as a regular student with not more than two units of condition, but entrance conditions, if any, must be made up during the first year of residence.

Admission to the College of Engineering may be by certificate or by examination. Candidates for admission must be at least sixteen years of age. Graduates of academies or high schools should obtain certificates of work done, showing the ground covered and the grade received in each study. These certificates should be sent to the Registrar, College of Engineering, at least one week before the opening of the fall semester. It is advisable to send them in much earlier. Certificate blanks may be had on request. Candidates who cannot present such certificates may be admitted on examination. Examinations for this purpose will be held September 23, 1918.

ADVANCED STANDING

Students from other colleges seeking admission to this college must present evidence of honorable dismissal from the institution last attended and must present certificates showing (1) a full record of the applicant's preparation for college, (2) his college record, subject by subject, with the grade obtained in each subject and the year of the course in which it was taken. He should submit a catalog of his college, bearing his name, and of the issue current at the time of his admission to that college. Students from other colleges must first meet the entrance requirements to this college, after which the amount of advanced credit to be obtained by certificate will be estimated by a committee of the Faculty, but not finally placed to

his credit until the student has been in residence in this college for one semester. Advanced credit without examination will be given only for work done in an approved college. Claims for advanced credit must be made during the first year of residence and not later than September of the collegiate year in which the candidate expects to graduate.

College credit for work done in a secondary school in excess of the requirements for admission can be given only on examination provided through the Registrar's office, and on the basis of five semester hours of credit for one unit of work. An exception to the examination rule is made in foreign language subjects continued in college during the first year, where the subsequent work is a sufficient test of the quality of the earlier work. Applications for such credit and for examination must be made to the Registrar during the first semester of residence and the examination must be taken at one of the regular dates set, viz.: the Wednesday of the opening week in September, or the Saturday following regular examinations in February. Advanced credit can be allowed only in Mathematics, foreign languages, or such other subjects taken in the last year of the secondary school course as may be approved by the Committee on Advanced Standing. No examination for advanced credit will be allowed after the first year of residence nor in subjects foreign to the college curriculum.

Courses of Study

The College of Engineering offers two courses of study, each five years in length, one in Mechanical and Electrical Engineering and the other in Civil Engineering. These courses are alike in character and the same in content to the end of the third year.

For the satisfactory completion of the first four years of either course, the degree, Bachelor of Science, will be given by the College of Liberal Arts.

The degree, Electrical Engineer, will be given by the College of Engineering at the end of the five-year course in Mechanical and Electrical Engineering, and the degree, Civil Engineer, at the end of the five-year course in Civil Engineering.

COURSE IN MECHANICAL AND ELECTRICAL ENGINEERING

	Semester Hours	
Freshman Year	First Semester	Second Semester
English A1	3	3
French A	3	3
Physics A1	4	4
Mathematics A3	5	5
Mechanical Drawing, Engineering A1, or Shop Work, Engineering A2	2	..
Mechanical Drawing, Engineering A1, or Shop Work, Engineering A2	..	2
Summer Work	..	2
Sophomore Year		
German A	3	3
Physics B1	3	3
Calculus, Mathematics B1	3	3
Chemistry A	4	4
Surveying, Engineering B2	3	3
Shop Work, Engineering B1	1	1
Summer Surveying, Engineering B3	..	6

	Semester Hours First Semester	Semester Hours Second Semester
Junior Year		
Economics A	3	3
Physics C1	3	3
Chemistry B1	4	..
*Chemistry B2	..	4
Geology A1	4	..
*Geology A3 or B9	..	4
Descriptive Geometry, Kinematics, and Graphical Statics, Engineering C1	3	3
Summer Work	..	2
Senior Year		
English B1	2	2
Structural Mechanics, Engineering D3	3	3
Calculus, Mathematics C1	3	3
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Electrical Engineering, Engineering D6	3	3
Elective	3	3
Summer Work	..	2
Fifth Year		
Hydraulic Engineering, Engineering E4	3	3
Thermodynamics, Engineering E1	4	..
The Public Relations of Engineers, Engineering E2	..	2
Thesis, Engineering E7	2	4
Engines, Engineering E3	3	3
Advanced Electrical Engineering, Engineering E5	3	..
Electric Power Plant Engineering, Engineering E6	..	3
Elective	2	2

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*The student may omit either Chemistry B2 or the second semester of Geology.

COURSE IN CIVIL ENGINEERING

The first three years of this course are the same as those in the course in Mechanical and Electrical Engineering shown above.

	Semester Hours First Semester	Semester Hours Second Semester
Senior Year		
English B1	2	2
Structural Mechanics, Engineering D3	3	3
Calculus, Mathematics C1	3	3
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Electrical Machinery, Engineering D5	3	..
Heat Engines, Engineering D4	..	3
Elective	3	3
Summer Work	..	2
Fifth Year		
Hydraulic Engineering, Engineering E4	3	3
Railroad Engineering, Engineering E10	4	..
The Public Relations of Engineers, Engineering E2	..	2
Thesis, Engineering E7	2	4
Structures, Engineering E9	5	..
Bridges, Engineering E8	..	5
Elective	3	3

Each course may be taken precisely as shown above by a student who enters the College with the standard preparation which includes English three units, Algebra one and one-half units, Plane Geometry one unit, Solid Geometry one-half unit, French two units, and German two units. If however the student enters College deficient in any of the subjects enumerated in the preceding sentence and the deficiency is not counterbalanced by excess elsewhere in his preparation of the character indicated later in this paragraph, it will

be impossible for him to complete either engineering course in five years without securing more than an average of seventeen semester hours of credit in each semester. Only an exceptionally strong student may expect to secure more than seventeen hours of credit per semester. Certain subjects when accepted for entrance credit constitute an excess in the sense that they relieve the student offering them of some college work which would otherwise be required of him in the engineering courses. These are College Algebra, Plane Trigonometry, Chemistry, a second unit of Mechanical Drawing, a second unit of Manual Training, and such preparation in foreign language as will leave the student less than twelve semester hours of foreign language to be taken in college in order to meet the requirements for the degree of Bachelor of Science which are shown in the Catalog of the University. As an example it may be stated that a student who presents three units of German or Latin, and two of French, is required to take in college French A only, six semester hours, instead of both French A and German A as listed above, twelve semester hours.

For recitations or lectures one semester hour of credit is given for one period, fifty minutes, each week, during one semester. For shop work, drafting or laboratory work, one semester hour of credit is given for one three-hour period each week during one semester.

REQUIRED SUMMER WORK

During each of the three summers following the first, third and fourth years the student is required to do practical work for at least six weeks, of such a character as to furnish experience of value to him as a prospective engineer. The credit assigned to six weeks of such approved work is two semester hours.

Under this requirement, students have acted as rodmen on city surveys, rodmen on the United States Lake Survey, workers in the tool room of a factory, helpers in the installation of heavy machinery in a new steam-electric power plant, foremen of gangs of laborers, helpers in the wiring of telephone switchboards, assistants in cement testing, computers for the Carnegie Institution, inspectors with a

company engaged in electric lighting and power distribution, and have worked on milling and machine work, figuring estimates, making tracings, and on land and topographical surveys.

During the summer following the second year the student is required to do field work in surveying for six weeks immediately following commencement, Engineering B3, credit six semester hours. This is a regular college course under the direction of college professors.

DESCRIPTION OF COURSES

The following paragraphs give more specific information in regard to the separate courses enumerated above as together constituting the courses in Mechanical and Electrical Engineering and in Civil Engineering.

English A1. Composition and Rhetoric; Brief Survey of English Literature—Required of all students in their first year. Three semester hours throughout the year.

English A2. Composition and Rhetoric—Required of students whose preparation is found to be insufficient for English A1. The work of the first semester is continued two hours a week in the second semester and attendance is required until the student's work is brought consistently up to a satisfactory standard.

French A. Modern French—Fraser and Squair's Grammar, Part II. Composition, conversation, and dictation. Three semester hours throughout the year. Open to students who present two units of French for entrance. If the student has presented no French for entrance he must take French AA, five semester hours throughout one year, in college before being admitted to French A, or if he has presented one unit of French for entrance, he must ordinarily take French AB, three semester hours throughout one year, in college before being admitted to French A.

German A. Intermediate German—Modern prose writers, classic drama and lyrics. Three semester hours throughout the year.

Open to students who present two units of German for entrance. If the student has presented no German for entrance he must take German AA, five semester hours throughout one year, in college before being admitted to German A, or if he has presented one unit of German for entrance he must ordinarily take German AB, three semester hours throughout one year, in college before being admitted to German A.

If the student has offered for entrance two units of French and two of German, he is advised to take French A in the first year and German A in the second year, but the order may be reversed. If other language units than those named in the preceding sentence have been offered for entrance, the student is required to take such language courses as will satisfy the language requirement for the degree of Bachelor of Science. These are not necessarily the courses French A and German A. For example, if a student has presented two or three units of Latin or of Greek for entrance he may be released, both as to entrance credits and as to college work, from a part of French or German. For complete information on this point, consult the statement of prescribed courses for the degree of Bachelor of Science, in the University catalog.

Mathematics A3. Plane Trigonometry, Algebra and Analytical Geometry—This is a course in which Plane Trigonometry, Algebra and Analytical Geometry are given together in one continuous course. Open to students who have presented one and a half units of Algebra for admission. Five semester hours throughout the year.

If a student has presented College Algebra or Plane Trigonometry for entrance, instead of taking Mathematics A3 in the freshman year, he is required to take three semester hours in each of two semesters in courses so arranged that with the work offered for entrance they will be equivalent to Mathematics A3.

Mathematics B1. Differential and Integral Calculus—A first course in Calculus, including its simpler applications. Open to students who have completed Mathematics A3, or an equivalent. Three semester hours throughout the year.

Mathematics C1. Advanced Calculus—Infinite series; Taylor's theorem; partial differentiation; differential geometry; definite integrals over curves, surfaces and volumes; the Eulerian functions; differential equations. Open to students who have completed Mathematics B1. Three semester hours throughout the year.

Physics A1. General Physics—First semester—General properties of matter, wave-motion, sound, heat. Second semester—Electricity, magnetism, light. An introductory course requiring no mathematics beyond the requirements for entrance to college, intended to acquaint the student with the elementary facts, the method, and the general principles of physical science. Text-book: Crew's General Physics. Three lectures and one laboratory exercise each week. Open to all students. Four semester hours throughout the year.

Physics B1. Mechanics—An elementary experimental study of forces, moments of force, moments of inertia, elasticity, hydromechanics, an introduction to advanced Physics and Engineering. This is a course in pure Dynamics, and serves as an introduction to Applied Mechanics. Two lectures and one laboratory exercise each week. The laboratory work is guided by specially prepared instructions. Open to students who have completed Physics A1, or its equivalent, and who have completed or are taking Mathematics B1. Three semester hours throughout the year.

Physics C1. Electricity and Magnetism—The more general laws of electricity and magnetism are discussed; the practical equations employed in the laboratory are derived and discussed. The laboratory work includes the measurement by one or more methods of current, resistance, electromotive force, temperature-coefficients, capacity; a study of the magnetic properties of iron and steel, thermoelectric effects, the use of the electrometer, the Carey Foster bridge, potentiometer, copper coulometer, etc. Open to students who have completed Mathematics B1 and who have completed or are taking Physics B1. Two lectures and one laboratory exercise each week. Three semester hours throughout the year.

Chemistry A. General Chemistry, Elementary—Text and laboratory work. Open to all students. Four semester hours throughout the year.

Chemistry AB. General Chemistry—To supplement the high school course, making the total equivalent to Chemistry A. Open to students who present one unit of chemistry for admission. Four semester hours for one semester, to be taken in either semester.

Chemistry B1. Qualitative Analysis—Analysis of simple mixtures accompanied by lectures and quizzes. Recitations and laboratory work. Open to students who have completed Chemistry A or an equivalent. Four semester hours for one semester, to be taken in either semester.

Chemistry B2. Organic Chemistry—Lectures and quizzes on the hydrocarbons and their derivatives. Laboratory preparation and study of typical organic compounds. Recitations and laboratory work. Open to students who have completed Chemistry A and B1 or an equivalent. Five semester hours for one semester, to be taken in either semester. One semester hour is credited as an elective.

Geology A1. General Geology—A general introduction to Geology. Lectures, recitations and laboratory work. Open to Sophomores, Juniors and Seniors. Four semester hours for one semester, to be taken in either semester.

Geology A3. Mineralogy—Crystallography, descriptive mineralogy, and determinative mineralogy of the common ores and rock forming minerals. Open to students who have completed in college or in high school a year course in Chemistry. Four semester hours in the second semester only.

Geology B5. Metallurgy—Fuels, refractory and cementing materials, metallurgy of iron and steel. Open to those students of Engineering who have completed Chemistry A. Two semester hours in the first semester only.

Geology B9. Historical Geology—A history of the earth, with special reference to the evolution of the North American Continent. Open to students who have completed Geology A1. Four semester hours in the second semester only.

Economics A. The Elements of Economics—First semester—An examination of the fundamental principles of economics. Second semester—Application of these principles to practical problems. Open to Sophomores, Juniors and Seniors. Three semester hours throughout the year.

English B1. Types of English Literature; Composition—Lectures, recitations, written reports and themes, and reading. Open to students who have completed the required English of the first year. Two semester hours throughout the year.

Electives—Six semester hours of electives are provided for in the senior year of the Mechanical and Electrical Engineering course and four in the fifth year. In the fourth and fifth years of the Civil Engineering course a total of twelve hours of electives are required. These electives are limited to courses given in the College of Liberal Arts, the choice to be approved by the Director.

Engineering A1. Mechanical Drawing—An elementary course in the technique of mechanical drawing, requiring no previous knowledge of drawing. Freehand lettering, exercise drawing, freehand sketching, shop drawing in pencil, tracing in ink on tracing cloth. Open to all students. Two drawing periods each week. Two semester hours for one semester, to be taken in either semester.

Engineering A2. Freshman Shop Work—A series of elementary practical exercises in the shop, upon a wide variety of subjects, the object being to bring out the principles involved, to acquaint the student with a considerable range of mechanical experience, and to cultivate habits both of logical thinking and of accurate work. The exercises involve some wood turning, pattern making, filing, scraping, sawing, punching, riveting, brazing, metal turning, shaping, planing, milling, grinding, etc. These exercises are guided by assigned readings, blue-printed instructions and by lectures on mechanical princi-

ples and processes, with occasional written work. Open to all students. Two shop periods each week. Two semester hours for one semester, to be taken in either semester.

Ordinarily it is expected that an engineering student will take Engineering A1 in one semester and Engineering A2 in the other semester of his freshman year.

Engineering B1. Sophomore Shop Work—This is a more intensive course than Engineering A2, limited mainly to pattern work, machine work, and tool making. The work is upon problems rather than exercises, and in them the student is given an opportunity to show his ingenuity and his grasp of the subject; while his work is directed in a general way, he is not given detailed instructions. The objects made are generally parts of some machine; this emphasizes the need for accuracy and gives a practical turn and interest to the subject. The work naturally introduces the student to a somewhat advanced knowledge of machines and processes. Open to students who have completed Engineering A2. One shop period each week. One semester hour throughout the year.

Engineering B2. Surveying—The use of chains, tapes, compass, level, transit, and plane table; methods of land, topographic and hydrographic surveying, including stream measurement, mine surveying and city surveying. Text-book: Theory and Practice of Surveying, by J. B. Johnson and L. S. Smith. Open to students who have completed Engineering A1 and Mathematics A3. Two recitations and one field period each week. Three semester hours throughout the year.

Engineering B3. Summer Surveying—Applications under actual field conditions of the theory taught in Engineering B2. The outcome of the work will be a map of the region covered by the survey and much allied information. A new area will be covered each year, ordinarily adjacent to the area surveyed in the preceding year. Six weeks immediately following commencement. Open to students who have completed Engineering B2. Credit six semester hours.

Engineering C1. Descriptive Geometry, Kinematics and Graphical Statics—The course is divided into three equal parts: (1) Descriptive Geometry; first principles; point, line and plane. Text-book: Essentials of Descriptive Geometry, by Phillips and Millar. (2) Kinematics; elementary propositions; communication of motion by rolling and sliding contact, by link work, by wrapping connectors. Text-book: Elementary Mechanism, by Stahl and Woods. (3) Graphical Statics; general principles; concurrent and non-concurrent forces; moments; roof trusses; loads; reactions; stresses; wind load stresses; cantilever and unsymmetrical trusses. Text: Graphic Statics, by Malcolm. Open to students who have completed Engineering A1 and Mathematics A3. One recitation period and two drawing periods each week. Three semester hours throughout the year.

Engineering D1. Contracts and Specifications—The course deals with contracts and specifications as applied to engineering only. Recitations and lectures. Text-book: The Law of Contracts, by John C. Wait. Open to students who have sixty hours of credit. Two semester hours in the second semester only.

Engineering D2. Journal Meeting—The time is spent in reading and reviewing current engineering literature, the object being to acquaint the student with this fund of information, to show him the necessity of judicious selection from the great mass of such current literature, to indicate methods of selection, and to cultivate a habit of accurate reading. Open to students who have taken or who are taking Engineering D3, D4, D5, or D6. One laboratory period each week. One semester hour throughout the year.

Engineering D3. Structural Mechanics—The text-book work is upon the application of mechanics to the elementary parts of structures, taking up properties of materials, testing materials, elementary theory of elasticity, stresses and strains of beams, columns, shafts, tubes, curved bars, springs and bodies in rapid rotation; stability of piles and retaining walls; elementary theory of reinforced concrete. The laboratory work relates partly to standard methods of testing

materials such as steel and cement, but it is largely involved in an effort to bring to the clear comprehension of the student the various relations deduced in the text-book work upon the subject. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering D4. Heat Engines—A course in prime movers and general power plant equipment. Elementary thermodynamics. Construction and operation of steam engines, turbines and gas engines. Engine testing. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours in the second semester only.

Engineering D5. Electrical Machinery—A course in Direct and Alternating Current Machines. Special emphasis is placed upon the study of the fundamental principles involved and upon the application of these principles in practise. Open to students who have completed Mathematics B1 and Physics C1. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering D6. Electrical Engineering—First semester—A general study of the fundamental principles of Electrical Engineering and their applications to direct current machinery. Problems are assigned to illustrate quantitatively the principles involved. Second semester—A general study of the fundamental principles of single and polyphase alternating currents, with special reference to analytic and graphic methods of treatment. Elementary analysis of alternating current machinery. Open to students who have completed Physics C1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E1. Thermodynamics—The course consists of text-book work first upon the general theory of thermodynamics, and later upon its application to heat engines, taking up properties of gases, flow of gases, thermodynamics of air engines, internal combustion engines and air compressors, properties of steam and other

vapors, thermodynamics of steam engines and steam turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Four semester hours in the first semester only.

Engineering E2. The Public Relations of Engineers—A course of lectures and reading dealing with the relations of a practising engineer to other men. It will deal in part with biographies of engineers, the history of engineering, the purpose of organization and the conservation of natural resources. Open to students who have taken or who are taking Engineering E1, E3, E4, E5, E6, E8 or E9. Two semester hours in the second semester only.

Engineering E3. Engines—A detailed study of the steam engine, steam turbine, boiler plant equipment, gas engines and producer gas plants. Open to students who have taken or who are taking Engineering E1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E4. Hydraulic Engineering—The theory and application of the principles of hydrostatics and hydrodynamics; measurements of flow by pressure gauges, meters, Pitot tubes and weirs; path, energy and impulse of jets; flow through orifices, tubes and pipes with loss of energy or head due to contractions, expansions and nozzles; derivation and application of formulæ for discharge, velocity and pressure; work derived from moving vanes as in water wheels and turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E5. Advanced Electrical Engineering—Advanced analysis by the analytic and graphic methods of treatment of continuous and alternating current machinery, of general alternating current and of transient phenomena. Lectures, assigned reading, recitations and laboratory work. Open to students who have completed Engineering D6. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering E6. Electric Power Plant Engineering—A study of special problems in connection with the generation and transmission of electrical energy in large systems and in high potential systems. Emphasis is laid upon the proper relation of parts to form a complete plant. Lectures, assigned reading, recitations and laboratory work. Open to students who have completed Engineering E5. Two recitations and one laboratory period each week. Three semester hours in the second semester only.

Engineering E7. Thesis—Open to students in the last year in the Engineering course. Two semester hours in the first and four in the second semester.

Engineering E8. Bridges—A general course on the theory and design of bridges, taking up stone arches, reinforced concrete arches, culverts and steel bridges of many types. Open to students who have completed Engineering D3. Three recitations and two drawing periods each week. Five semester hours in the second semester only.

Engineering E9. Structures—A general course on the theory and design of foundations, retaining walls, tall chimneys, masonry dams and building construction. Open to students who have completed Engineering D3. Three recitations and two drawing periods each week. Five semester hours in the first semester only.

Engineering E10. Railroad Engineering—The use of the transit, chain, level, etc., in laying out simple, compound and vertical curves; methods of reconnaissance, preliminary and location surveys; turnouts, switches and wye tracks; profile and cross section surveys, and computation of earthwork; haul and mass diagrams; maps and drawings; the use of topographic surveys in location; drainage, waterways and bridge staking. Economic theory of railway location, construction, extension and maintenance. Field work consists of laying out a short line and of the practical application of methods of staking, computation and mapping given above. Open to students who have completed Engineering B2 and Mathematics B1. Three recitations and one field period each week. Four semester hours in the first semester only.

General Regulations

REGISTRATION

Every student is required to register in person at the office of the Registrar, College of Engineering, before entering upon college work, on the registration days specified in the calendar. Returning students who register after the close of this period are subject to a fee of two dollars.

On the registration days of the first semester the student must register for the work of the whole year. Changes may be made only with the consent of the Director. A course dropped without consent is regarded as a failure and is so recorded.

At the time of registration the student obtains from the Registrar his bill for tuition and fees for the semester. This should be paid at the Business Manager's Office within one week.

CLASSIFICATION

Students in the College of Engineering are grouped in five classes according to their credits in the office of the Registrar. The basis for their classification is as follows:

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first four years, and who have satisfied all entrance requirements, are classed as fifth year students.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first three years, and who have satisfied all entrance requirements, are classed as seniors.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first two years, and who have satisfied all entrance requirements, are classed as juniors.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first year, and

who have satisfied all entrance requirements, are classed as sophomores.

All other regular students are classed as freshmen, without regard to the date of admission.

GRADES OF SCHOLARSHIP, EXAMINATIONS, AND ATTENDANCE

In other matters of student regulation, such as examinations, grades of scholarship, class and chapel attendance, and physical training, the students of the College of Engineering are governed by the regulations stated in the general University Catalog and in the Undergraduate's Manual.

FEES AND EXPENSES

Matriculation Fee, paid by each student when he first enters the University	$ 5.00
Tuition and Incidentals, per year, except for Fifth Year students	150.00
Tuition and Incidentals, per year, for Fifth Year students	40.00

Tuition and Incidentals are payable one-half at the beginning of the first semester, one-half at the beginning of the second.

Laboratory Fees.

Engineering A1	$ 3.00 a semester
Engineering A2	8.00 a semester
Engineering B1	4.00 a semester
Engineering B2 or D3	5.00 a semester
Engineering C1, D4, D5, D6, E3, E4, E5, E6, E8, E9 or E10	3.00 a semester
Student Enterprise Fee	2.50 a semester
Fee for summer surveying course, Engineering B3	15.00
Diploma Fee	10.00

The average cost to a student of engineering for the first four years, of all tuition and fees, as enumerated above, is about $172 per year.

The laboratory fees for engineering courses are intended to cover ordinary depreciation of apparatus and the use of materials. The student is held responsible for any damage due to his negligence.

Laboratory fees are not refunded if the student continues in a course as long as two weeks.

The tuition fees will not be refunded except in case of sickness. If a student withdraws before the middle of the semester, on account of serious illness, one-half of his tuition fee will be refunded, on his obtaining from the Director a statement of honorable standing, and from a physician a certificate that his health will not permit him to remain in attendance. The student will also be required to return his receipted bill for tuition.

Reduced rates of tuition are given to sons of clergymen who are actively pursuing the work of the ministry ($53.00 per semester). Holders of old-time perpetual or transferable scholarships are given free tuition.

The remaining necessary expenses of a student, namely, board, room, laundry, text-books and stationery, for nine months, vary from $280 to $460, the average being about $360 in normal times. In 1918-1919 these expenses will necessarily be higher on account of war conditions.

DORMITORIES

A new system of thirteen dormitories for men students is now in use. Nine of these buildings are designed for fraternities, whose alumni have contributed toward their cost, and the remaining four are open for rental by any of the men students of the University.

The buildings are architecturally beautiful and are meant to be models in comfort and sanitation. They are fireproof, lighted by electricity, and heated by steam. On the first floor of each building is a large enclosed porch, and a well equipped club room with an open fire-place, rugs, tables, and lounging chairs. There are also a few rooms for individual students on this floor. The second and third floors are made up entirely of single rooms.

Each student's private room is furnished with a single bed, mattress and pillow, a chiffonier, a combined study table and bookcase, two chairs, a rug, and window shades. The student furnishes his own bedding and towels, but the University takes charge of the laundering of these. In the interest of economy, electric lighting is not included in the general charge, but is apportioned pro rata monthly to the occupants of the building.

In the men's dormitories room rent is payable at the beginning of each semester and the charge to each student for the use of a furnished single room, including care, heat and water, varies from ninety to one hundred and ten dollars a year. The rental for private rooms on the first floor is somewhat higher.

The Registrar of the College of Liberal Arts is the renting officer of the dormitories; and men of the College of Engineering not living at their homes or in fraternity houses are required to live in the dormitories unless no rooms are available, or they obtain through the Registrar written permission to room elsewhere. Blank application forms for such permission will be furnished on request.

A chart showing the location and rental prices of rooms may be had from the Registrar upon application.

SCHOLARSHIPS

A few scholarships, worth $120 each, are awarded annually (five in 1918-1919) to select members of the incoming class, upon applications endorsed by the principal and faculty of the secondary school from which the applicant graduates. The applicant must meet the full entrance requirements and must present certificates from the teachers in his secondary school for excellence of character and scholarship, for physical vigor, manliness and promise of usefulness as a citizen. The award is made at the University by a committee of the College faculty.

A few scholarships, worth $120 each, are awarded annually (four in 1918-1919) to select members of the upper classes.

The upper class scholarship known as the *Swift Scholarship* has been given by Mrs. Gustavus F. Swift to members of the upper classes.

OPPORTUNITIES FOR SELF-HELP

Some students in Evanston have been able, while in college, to earn the cost of their living in full, and every year a large percentage earn a considerable portion of their expenses, and at the same time maintain a high standing in their studies. It is never advisable, however, for a student to undertake more work of this kind than is necessary for his personal support, and if the amount is excessive he should plan to give more than the normal five years to his college course.

The General Secretary of the Young Men's Christian Association maintains a bureau to assist students in finding employment. The positions most frequently open to young men are those as waiters at boarding places or as attendants in private houses in the care of gardens or furnaces. While the aggregate of the annual earnings of students is a large sum, the number of positions open is limited and no assurances can be given that employment will be found. Only the most faithful and self-reliant students should undertake self-support, and in no case should a student come to Evanston without sufficient means to meet expenses for at least a half-year.

RELIGIOUS AND SOCIAL LIFE OF STUDENTS

The charter of the University provides that "no particular religious faith shall be required of those who become students of this institution." Students are expected to attend public worship on Sunday in the church of their choice. Chapel service is held at ten o'clock on each week day, except Saturday, throughout the college year. Attendance upon at least two-fifths of these services is required. Under the direction of the Young Men's Christian Association religious meetings are held each week.

In athletics, in social life and in the use of the buildings, there is no separation of the students of Engineering from the students of Liberal Arts. Engineering students go to the various buildings of

the College of Liberal Arts for recitations in other than strictly engineering subjects. They share in the use of the University Library. They have free access to the new gymnasium, the largest in the United States. Their social life is mingled with that of the Liberal Arts students in one university group.

The Engineering Society, composed of students of engineering and members of the engineering faculty, provides numerous addresses by prominent engineers and organizes inspection trips to points of engineering interest. The members also furnish many additional programs so that the society holds a meeting nearly every week.

An Engineering Assembly, attended by all students of engineering and by the engineering faculty, occurs eight times during each year. The general purpose of these assemblies is to develop a group consciousness in the students of engineering and to bring forward matters of especial interest to the group.

Some Advantages of the College of Engineering at Northwestern University

It offers a thorough professional course rather than a purely practical course. It places the emphasis on the fundamentals which are common to all branches of engineering. It trains its graduates for unlimited growth as engineers and for possible leadership.

The engineering courses, five years in length, are so arranged as to give each man his general broad training at the same time that he pursues his engineering studies. The engineering students are closely associated with the larger group of Liberal Arts students, of which they, in fact, form a part.

In the purely engineering part of the course, the proportion of professors to students is much larger than is customary and each student, therefore, receives an unusual amount of attention.

There is more engineering in progress within fifty miles of the loop district of Chicago than in any area of the same size anywhere in the United States with the possible exception of New York City.

The students of this College thus have an unsurpassed opportunity to keep in touch with engineering practise and to meet engineers.

The College of Engineering is a young organization in excellent condition to take advantage of the experience of other colleges in training engineers.

It is provided with ample shop and laboratory equipment, selected with unusual care and deliberation, purely for teaching purposes and housed in an excellent building.

Inquiries for further information, requests for the catalog of the University, for scholarship application blanks, and for blank forms of certificates from secondary schools may be addressed to John F. Hayford, Director, College of Engineering, Northwestern University, Evanston, Illinois.

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Northwestern University

Evanston — Chicago

¶ THE COLLEGE OF LIBERAL ARTS, in Evanston, offers well organized courses for general education, with special preparation for the professions and for other pursuits requiring broad training.

¶ THE GRADUATE SCHOOL, in Evanston, extends non-professional training and research beyond the College curriculum, with courses leading to advanced degrees.

¶ THE MEDICAL SCHOOL, in Chicago, is one of the best equipped in the United States and its reputation for efficiency is well-established. Numerous hospitals in close proximity are open to students. Clinical material is abundant.

¶ THE LAW SCHOOL, in Chicago, offers unexcelled library and research facilities. Its courses leading to degrees prepare for practice in any state.

¶ THE COLLEGE OF ENGINEERING, on the campus in Evanston, offers a five-year course of technical training in a University environment, leading to the degrees of Bachelor of Science and Civil Engineer or Electrical Engineer.

¶ THE DENTAL SCHOOL, in Chicago, is recognized as one of the leading schools for dental training and investigation. Its clinical facilities are unsurpassed.

¶ THE SCHOOL OF MUSIC in three well-equipped buildings offers exceptional advantages for the thorough study of music, professional or otherwise. It is located in Evanston.

¶ THE SCHOOL OF COMMERCE, in Chicago and Evanston, offers professional and scientific education for business with emphasis on the training of business executives. Day and evening work, laboratory courses, and business research.

¶ THE SCHOOL OF ORATORY, in Evanston, is unique in having university relations. It offers a well arranged course in interpretative literature, and a special course in Physical Education for teachers.

For information regarding any School of the University, address the President's Office, Northwestern University Building, Chicago, Illinois.

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Northwestern University Bulletin

COLLEGE *of* ENGINEERING ANNOUNCEMENTS 1919-1920

1851

Published Weekly by Northwestern University
Northwestern University Building
CHICAGO

Vol. XX, No. 7 August 16, 1919

NORTHWESTERN UNIVERSITY

Special Advantages of the College of Engineering

A thorough professional course rather than a purely practical one, with five years of broad training.

Small classes in which each student receives an unusual amount of individual attention.

A splendid building designed for the purpose, and up-to-date apparatus carefully selected to promote effective teaching.

Accessibility to great engineering projects, with unsurpassed opportunities to meet engineers and keep in touch with engineering practice.

A young thriving college in an old university.

Northwestern University Bulletin

COLLEGE *of* ENGINEERING ANNOUNCEMENTS
1919-1920

Published by the University
August, 1919

SWIFT HALL OF ENGINEERING

Swift Hall of Engineering, the gift of Mrs. Gustavus F. Swift and her son, Edward F. Swift, was dedicated in 1909. The building measures fifty-eight by one hundred and twenty-six feet; the exterior is of Bedford limestone, and presents architectural lines that are of the best; the interior is a model of appropriate decoration, convenience, safety and strength; it has concrete floors and stairways throughout. It presents five working stories, all well lighted and of good height, and the large rooms at the ends of the building are free from columns. From the beginning, it was especially planned as the home of the College of Engineering. The building is in a delightful location overlooking Lake Michigan.

Faculty

LYNN HAROLD HOUGH, B.A., B.D., D.D.
President

JOHN FILLMORE HAYFORD, C.E., Sc.D.
Director

OLIN HANSON BASQUIN, Ph.D.
Professor of Applied Mechanics

WILLIAM CHARLES BAUER, B.S., Sc.D.
Professor of Electrical Engineering

*HERBERT SHAW PHILBRICK, B.A., B.S.
Professor of Mechanical Engineering

WILLIAM HENRY BURGER, B.S.
Professor of Civil Engineering

MILBY ROY HAMMER, B.S.
Professor of Drawing

JAMES TAFT HATFIELD, Ph.D.
Professor of German Language and Literature

HENRY CREW, Ph.D.
Professor of Physics

EDOUARD PAUL BAILLOT, L.H.D.
Professor of Romance Languages

ULYSSES SHERMAN GRANT, Ph.D.
Professor of Geology

ARTHUR CHARLES LEWIS BROWN, Ph.D.
Professor of English

---

*On leave of absence.

Frederick Shipp Deibler, Ph.D.
Professor of Economics

David Raymond Curtiss, Ph.D.
Professor of Mathematics

William Frank Bryan, Ph.D.
Associate Professor of English

Murray Arnold Hines, Ph.D.
Assistant Professor of Chemistry

Elton James Moulton, Ph.D.
Assistant Professor of Mathematics

Keith Kuenzi Smith, Ph.D.
Assistant Professor of Physics

Frederick Laird Kerr, M.A.
Registrar

Vivien K. Rathbun
Assistant Registrar

Andrews Allen, C.E.
Lecturer on Contracts and Specifications

Elmer Martin Leesman, LL.B.
Lecturer on Contracts and Specifications

Arthur Wald
Shop Assistant

Calendar

1919-1920

1919		
Sept. 22	Mon.	Academic year 1919-1920 begins; examinations for admission; first day of registration
Sept. 24	Wed.	Second examinations; last day of registration
Sept. 25	Thu.	Class work begins
Nov. 27	Thu.	Thanksgiving Recess, to Sunday, November 30, inclusive
Dec. 20	Sat.	Christmas Recess, to January 5, Monday, inclusive
1920		
Jan. 6	Tue.	Class work resumed
Jan. 26	Mon.	Mid-year examinations begin
Feb. 4	Wed.	Last day of registration for second semester
Feb. 5	Thu.	Second semester begins; class work resumed
Feb. 7	Sat.	Second examinations
Apr. 1	Thu.	Easter Recess, to April 6, Tuesday, inclusive
Apr. 6	Tue.	Second examinations
May 31	Mon.	Regular examinations begin
June 16	Wed.	SIXTY-SECOND ANNUAL COMMENCEMENT
June 17	Thu.	Beginning of summer surveying
July 28	Wed.	End of summer surveying

Historical Note

THE charter of Northwestern University was signed by the Governor of Illinois on January 28, 1851. The corporation consists of forty-two trustees. An amendment to the charter provides that no intoxicating liquors shall be sold within four miles of the University.

The trustees selected as the seat of the University a tract of land on the shore of Lake Michigan, twelve miles north from the heart of Chicago. Here in 1855 the first University building was erected and about its location has grown up the City of Evanston. Here are the College of Liberal Arts, the College of Engineering, the School of Music, and the School of Oratory. The schools of Medicine, Law, Dentistry and Commerce are located in the City of Chicago.

The College of Liberal Arts, the oldest department of the University, was opened to students in the fall of 1855. From its small beginning it has grown, not by rapid expansion or by large benefactions, but by steady gains along conservative lines—each of its sixty years adding some improvements to its physical and educational equipment. The work of the College of Liberal Arts is mainly directed toward furnishing opportunities for a liberal culture or general education. The regulations affecting the choice of studies are such that the student may elect a large part of his work along lines in which he is especially interested.

In recent years a demand for instruction in engineering gradually made itself felt. A gift for the erection of an engineering building at Evanston and for its endowment led the Trustees of the University to take action in June, 1907, resulting in the establishing of a College of Engineering. This gift came from Mrs. Gustavus F.

Swift and her son, Edward F. Swift. The building, known as the Swift Hall of Engineering, was dedicated in May, 1909. It is now occupied by the College of Engineering. The Department of Mathematics of the College of Liberal Arts also has offices and recitation rooms in the building.

In 1917-1918, the College of Engineering had a total registration of eighty-six students.

STATEMENT OF PURPOSE

The purpose of the College of Engineering of Northwestern University is to furnish to each student a thorough training for the profession of engineering, combined with a general training of the man. The College aims to train engineers for the greatest average effectiveness in a lifetime rather than for the greatest effectiveness in the first year after graduation. It aims to develop a capacity for unlimited growth. Hence strong emphasis is laid on those studies which tend to develop the man as well as on those which furnish training in engineering.

In keeping with these ideals, the courses in engineering introduce an unusual number of those non-technical studies that serve to give a general education and to develop the thinking power of the students. Unusual stress is laid upon Mathematics, upon Physics and other sciences fundamental to engineering and upon the principles which are broadly applicable to all engineering. The courses are five years in length, because past experience among colleges of engineering shows that four years is too short a time for the thorough professional training contemplated. At the end of four years the student of engineering will have secured as thorough a general training as one who comes to Northwestern University for general training alone. In recognition of that fact, he will be given the degree of Bachelor of Science by the College of Liberal Arts. During the fifth year the general training of the student is continued and he completes his professional course in engineering.

The motto of the College is "Culture for Usefulness." This motto calls for an effort to obtain for the student the broadest

culture attainable in five years in order to equip him, as a man and as an engineer, for the greatest possible usefulness in the world in the united struggle of man for progress.

Requirements for Admission

Candidates for admission without entrance conditions must qualify by examination or by certificate on fifteen units of High School work. The unit is a course of study requiring a daily recitation on a prepared topic for a full school year, and covering in the various subjects the work defined in the University Catalog.

English, three units; Algebra, one and a half units; and Plane Geometry, one unit, are required of all candidates. A choice is allowed in the selection of other subjects, but the choice must include either four units of foreign language or two units of foreign language plus two units chosen from the following group: College Algebra one-half unit, Plane Trigonometry one-half unit, Solid Geometry one-half unit, Physics one unit, Chemistry one unit, Manual Training one or two units, and Mechanical Drawing one or two units. The choice of foreign language is limited to Latin, Greek, French, German and Spanish and a certain maximum number of units in each as indicated in the table which follows. A single unit of any language will be accepted to meet the specific foreign language requirement only when accompanied by at least three units of some other language or two units each of two others. The remaining five and one-half units required to make an aggregate of fifteen units may include any subjects commonly appearing as a part of a high school course, provided that no subject is presented for less than a half unit of credit. Vocal music and physical training are not recognized for credit.

The following table indicates the subjects commonly presented for admission credit:

Latin	2, 3 or 4 units
Greek	2 or 3 units
German	2 or 3 units
French	2 or 3 units
Spanish	2 units
College Algebra	½ unit
Plane Trigonometry	½ unit
Solid Geometry	½ unit
Physiography	1 unit
Physics	1 unit
Botany	1 unit
Zoology	1 unit
Chemistry	1 unit
Ancient History	1 unit
Mediæval and Modern History	1 unit
English History	1 unit
American History (or with Civil Government)	1 unit
Civil Government	½ unit
Political Economy	½ unit
Commercial Geography	½ unit
Commercial Law	½ unit
Physiology	½ unit
Mechanical Drawing	1 or 2 units
Manual Training	1 or 2 units

One unit of entrance credit in Mechanical Drawing may be given for twelve hours work per week for a full school year, or an equivalent amount of time, provided the work is of an acceptable character. A second unit of credit may be given in Mechanical Drawing only in case the course in drawing taken in school covers the full equivalent of the course Engineering A1 of the College of Engineering.

One unit of entrance credit in Manual Training may be given for twelve hours work per week for a full school year, or an equivalent amount of time, provided the work is of an acceptable character. A second unit of credit may be given in Manual Training only in case the course in Manual Training taken in school covers the full equivalent of the course Engineering A2 of the College of Engineering.

For a statement in detail of the definitions of other entrance units consult the Catalog of the University.

Each student in engineering who has not presented Solid Geometry for entrance will be required to take Solid Geometry, three hours for one semester, in the first year. As this will be an extra task,

making it difficult for the student to keep up with his class, each candidate is advised to present this subject for entrance if possible.

So, too, there are various other ways in which a student in meeting the entrance requirements may by his selection of the subjects presented either lighten his later college work, or may so handicap himself as to make it difficult to secure an engineering degree in five years. For a general suggestion on this point, consult page 14.

A candidate may be admitted to the College of Engineering as a regular student with not more than two units of condition, but entrance conditions, if any, must be made up during the first year of residence.

Admission to the College of Engineering may be by certificate or by examination. Candidates for admission must be at least sixteen years of age. Graduates of academies or high schools should obtain certificates of work done, showing the ground covered and the grade received in each study. These certificates should be sent to the Registrar, College of Engineering, at least one week before the opening of the fall semester. It is advisable to send them in much earlier. Certificate blanks may be had on request. Candidates who cannot present such certificates may be admitted on examination. Examinations for this purpose will be held September 22, 1919.

ADVANCED STANDING

Students from other colleges seeking admission to this college must present evidence of honorable dismissal from the institution last attended and must present certificates showing (1) a full record of the applicant's preparation for college, (2) his college record, subject by subject, with the grade obtained in each subject and the year of the course in which it was taken. He should submit a catalog of his college, bearing his name, and of the issue current at the time of his admission to that college. Students from other colleges must first meet the entrance requirements to this college, after which the amount of advanced credit to be obtained by certificate will be estimated by a committee of the Faculty, but not finally placed to

his credit until the student has been in residence in this college for one semester. Advanced credit without examination will be given only for work done in an approved college. Claims for advanced credit must be made during the first year of residence and not later than September of the collegiate year in which the candidate expects to graduate.

College credit for work done in a secondary school in excess of the requirements for admission can be given only on examination provided through the Registrar's office, and on the basis of five semester hours of credit for one unit of work. An exception to the examination rule is made in foreign language subjects continued in college during the first year, where the subsequent work is a sufficient test of the quality of the earlier work. Applications for such credit and for examination must be made to the Registrar during the first semester of residence and the examination must be taken at one of the regular dates set, viz.: the Wednesday of the opening week in September, or the Saturday following regular examinations in February. Advanced credit can be allowed only in Mathematics, foreign languages, or such other subjects taken in the last year of the secondary school course as may be approved by the Committee on Advanced Standing. No examination for advanced credit will be allowed after the first year of residence nor in subjects foreign to the college curriculum.

Courses of Study

The College of Engineering offers two courses of study, each five years in length, one in Mechanical and Electrical Engineering and the other in Civil Engineering. These courses are alike in character and the same in content to the end of the third year.

For the satisfactory completion of the first four years of either course, the degree, Bachelor of Science, will be given by the College of Liberal Arts.

The degree, Electrical Engineer, will be given by the College of Engineering at the end of the five-year course in Mechanical and Electrical Engineering, and the degree, Civil Engineer, at the end of the five-year course in Civil Engineering.

COURSE IN MECHANICAL AND ELECTRICAL ENGINEERING

	Semester Hours	
	First Semester	Second Semester
Freshman Year		
Mechanical Drawing, Engineering A1, or Shop Work, Engineering A2	2	..
Shop Work, Engineering A2, or Mechanical Drawing, Engineering A1	..	2
Mathematics A3	5	5
English A1	3	3
French A	3	3
Chemistry A	4	4
Summer Work	..	2
Sophomore Year		
Calculus, Mathematics B1	3	3
Physics A1	4	4
German A	3	3
Surveying, Engineering B2	3	3
Shop Work, Engineering B1	1	1
English B1	2	2
Summer Surveying, Engineering B3	..	6

	Semester Hours First Semester	 Second Semester
Junior Year		
Physics B1	3	3
Descriptive Geometry, Kinematics, and Graphical Statics, Engineering C1	3	3
Chemistry B1	5	..
Geology A1	5	..
*Chemistry B2	..	5
*Geology A3 or Geology B9	..	4
Economics A	..	5
Summer Work	..	2
Senior Year		
Physics C1	3	3
Electrical Engineering, Engineering D6	3	3
Structural Mechanics, Engineering D3	3	3
Mathematics C1	5	..
Elective	..	5
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Summer Work	..	2
Fifth Year		
Advanced Electrical Engineering, Engineering E5	3	..
Electric Power Plant Engineering, Engineering E6	..	3
Thermodynamics, Engineering E1	3	..
Engines, Engineering E3	3	3
Hydraulic Engineering, Engineering E4	3	3
The Public Relation of Engineers, Engineering E2	..	2
Elective	3	..
Advanced Mechanics, Engineering E11, or Elective	..	3
Thesis, Engineering E7	2	3

---

*The student may omit either Chemistry B2 or the second semester of Geology.

COURSE IN CIVIL ENGINEERING

The first three years of this course are the same as those in the course in Mechanical and Electrical Engineering.

	Semester Hours First Semester	 Second Semester
Senior Year		
Physics C1	3	3
Structural Mechanics, Engineering D3	3	3
Mathematics C1	5	..
Elective	..	5
Electrical Machinery, Engineering D5	3	..
Heat Engines, Engineering D4	..	3
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Summer Work	..	2
Fifth Year		
Structures, Engineering E9	5	..
Bridges, Engineering E8	..	5
Hydraulic Engineering, Engineering E4	3	3
Railroad Engineering, Engineering E10	4	..
The Public Relations of Engineers, Engineering E2	..	2
Elective	3	3
Thesis, Engineering E7	2	4

Each course may be taken precisely as shown above by a student who enters the College with the standard preparation which includes English three units, Algebra one and one-half units, Plane Geometry one unit, Solid Geometry one-half unit, French two units, and German two units. If however the student enters College deficient in any of the subjects enumerated in the preceding sentence and the deficiency is not counterbalanced by excess elsewhere in his preparation of the character indicated later in this paragraph, it will

be impossible for him to complete either engineering course in five years without securing more than an average of seventeen semester hours of credit in each semester. Only an exceptionally strong student may expect to secure more than seventeen hours of credit per semester. Certain subjects when accepted for entrance credit constitute an excess in the sense that they relieve the student offering them of some college work which would otherwise be required of him in the engineering courses. These are College Algebra, Plane Trigonometry, Chemistry, a second unit of Mechanical Drawing, a second unit of Manual Training, and such preparation in foreign language as will leave the student less than twelve semester hours of foreign language to be taken in college in order to meet the requirements for the degree of Bachelor of Science which are shown in the Catalog of the University. As an example it may be stated that a student who presents three units of German or Latin, and two of French, is required to take in college French A only, six semester hours, instead of both French A and German A as listed above, twelve semester hours.

For recitations or lectures one semester hour of credit is given for one period, fifty minutes, each week, during one semester. For shop work, drafting or laboratory work, one semester hour of credit is given for one three-hour period each week during one semester.

REQUIRED SUMMER WORK

During each of the three summers following the first, third and fourth years the student is required to do practical work for at least six weeks, of such a character as to furnish experience of value to him as a prospective engineer. The credit assigned to six weeks of such approved work is two semester hours.

Under this requirement, students have acted as rodmen on city surveys, rodmen on the United States Lake Survey, workers in the tool room of a factory, helpers in the installation of heavy machinery in a new steam-electric power plant, foremen of gangs of laborers, helpers in the wiring of telephone switchboards, assistants in cement testing, computers for the Carnegie Institution, inspectors with a

company engaged in electric lighting and power distribution, and have worked on milling and machine work, figuring estimates, making tracings, and on land and topographical surveys.

During the summer following the second year the student is required to do field work in surveying for six weeks immediately following commencement, Engineering B3, credit six semester hours. This is a regular college course under the direction of college professors.

DESCRIPTION OF COURSES

The following paragraphs give more specific information in regard to the separate courses enumerated above as together constituting the courses in Mechanical and Electrical Engineering and in Civil Engineering.

English A1. Composition and Rhetoric; Brief Survey of English Literature—Required of all students in their first year. Three semester hours throughout the year.

English A2. Composition and Rhetoric—Required of students whose preparation is found to be insufficient for English A1. The work of the first semester is continued two hours a week in the second semester and attendance is required until the student's work is brought consistently up to a satisfactory standard.

French A. Modern French—Composition, conversation, and dictation. Three semester hours throughout the year. Open to students who present two units of French for entrance. If the student has presented no French for entrance he must take French AA, five semester hours throughout one year, in college before being admitted to French A, or if he has presented one unit of French for entrance, he must ordinarily take French AB, three semester hours throughout one year, in college before being admitted to French A.

German A. Intermediate German—Modern prose writers, classic drama and lyrics. Three semester hours throughout the year.

Open to students who present two units of German for entrance. If the student has presented no German for entrance he must take German AA, five semester hours throughout one year, in college before being admitted to German A, or if he has presented one unit of German for entrance he must ordinarily take German AB, three semester hours throughout one year, in college before being admitted to German A.

If the student has offered for entrance two units of French and two of German, he is advised to take French A in the first year and German A in the second year, but the order may be reversed. If other language units than those named in the preceding sentence have been offered for entrance, the student is required to take such language courses as will satisfy the language requirement for the degree of Bachelor of Science. These are not necessarily the courses French A and German A. For example, if a student has presented two or three units of Latin or of Greek for entrance he may be released, both as to entrance credits and as to college work, from a part of French or German. For complete information on this point, consult the statement of prescribed courses for the degree of Bachelor of Science, in the University catalog.

Mathematics A3. Plane Trigonometry, Algebra and Analytical Geometry—This is a course in which Plane Trigonometry, Algebra and Analytical Geometry are given together in one continuous course. Open to students who have presented one and a half units of Algebra for admission. Five semester hours throughout the year.

If a student has presented College Algebra or Plane Trigonometry for entrance, instead of taking Mathematics A3 in the freshman year, he is required to take three semester hours in each of two semesters in courses so arranged that with the work offered for entrance they will be equivalent to Mathematics A3.

Mathematics B1. Differential and Integral Calculus—A first course in Calculus, including its simpler applications. Open to students who have completed Mathematics A3, or an equivalent. Three semester hours throughout the year.

Mathematics C1. Advanced Calculus—Infinite series; Taylor's theorem; partial differentiation; differential geometry; definite integrals over curves, surfaces and volumes; the Eulerian functions; differential equations. Open to students who have completed Mathematics B1. Five semester hours in the first semester.

Physics A1. General Physics—First semester—General properties of matter, wave-motion, sound, heat. Second semester—Electricity, magnetism, light. An introductory course requiring no mathematics beyond the requirements for entrance to college, intended to acquaint the student with the elementary facts, the method, and the general principles of physical science. Text-book: Crew's General Physics. Three lectures and one laboratory exercise each week. Open to all students. Four semester hours throughout the year.

Physics B1. Mechanics—An elementary experimental study of forces, moments of force, moments of inertia, elasticity, hydromechanics, an introduction to advanced Physics and Engineering. This is a course in pure Dynamics, and serves as an introduction to Applied Mechanics. Two lectures and one laboratory exercise each week. The laboratory work is guided by specially prepared instructions. Open to students who have completed Physics A1, or its equivalent, and who have completed or are taking Mathematics B1. Three semester hours throughout the year.

Physics C1. Electricity and Magnetism—The more general laws of electricity and magnetism are discussed; the practical equations employed in the laboratory are derived and discussed. The laboratory work includes the measurement by one or more methods of current, resistance, electromotive force, temperature-coefficients, capacity; a study of the magnetic properties of iron and steel, thermoelectric effects, the use of the electrometer, the Carey Foster bridge, potentiometer, copper coulometer, etc. Open to students who have completed Mathematics B1 and who have completed or are taking Physics B1. Two lectures and one laboratory exercise each week. Three semester hours throughout the year.

Chemistry A. General Chemistry, Elementary—Text and laboratory work. Open to all students. Four semester hours throughout the year.

Chemistry AB. General Chemistry—To supplement the high school course, making the total equivalent to Chemistry A. Open to students who present one unit of chemistry for admission. Four semester hours for one semester, to be taken in either semester.

Chemistry B1. Qualitative Analysis—Analysis of simple mixtures accompanied by lectures and quizzes. Recitations and laboratory work. Open to students who have completed Chemistry A or an equivalent. Five semester hours for one semester, to be taken in either semester. One semester hour is credited as an elective.

Chemistry B2. Organic Chemistry—Lectures and quizzes on the hydrocarbons and their derivatives. Laboratory preparation and study of typical organic compounds. Recitations and laboratory work. Open to students who have completed Chemistry A and B1 or an equivalent. Five semester hours for one semester, to be taken in either semester. One semester hour is credited as an elective.

Geology A1. General Geology—A general introduction to Geology. Lectures, recitations and laboratory work. Open to Sophomores, Juniors and Seniors. Five semester hours in the first semester only. One semester hour is credited as an elective.

Geology A3. Mineralogy—Crystallography, descriptive mineralogy, and determinative mineralogy of the common ores and rock forming minerals. Open to students who have completed in college or in high school a year course in Chemistry. Four semester hours in the second semester only.

Geology B5. Metallurgy—Fuels, refractory and cementing materials, metallurgy of iron and steel. Open to those students of Engineering who have completed Chemistry A. Two semester hours in the first semester only.

Geology B9. Historical Geology—A history of the earth, with special reference to the evolution of the North American Continent. Open to students who have completed Geology A1. Four semester hours in the second semester only.

Economics A. The Elements of Economics—An examination of the fundamental principles of economics, and the application of these principles to practical problems. Open to Sophomores, Juniors and Seniors. Five semester hours for one semester, to be taken in either semester.

English B1. Types of English Literature; Composition—Lectures, recitations, written reports and themes, and reading. Open to students who have completed the required English of the first year. Two semester hours throughout the year.

Electives—Five semester hours of electives are provided for in the senior year of both courses, and six in the fifth year. These electives are limited to courses given in the College of Liberal Arts, the choice to be approved by the Director, with the exception that Engineering E11 may be taken as an elective in the fifth year of the Mechanical and Electrical Engineering course.

Engineering A1. Mechanical Drawing—An elementary course in the technique of mechanical drawing, requiring no previous knowledge of drawing. Freehand lettering, exercise drawing, freehand sketching, shop drawing in pencil, tracing in ink on tracing cloth. Open to all students. Two drawing periods each week. Two semester hours for one semester, to be taken in either semester.

Engineering A2. Freshman Shop Work—A series of elementary practical exercises in the shop, upon a wide variety of subjects, the object being to bring out the principles involved, to acquaint the student with a considerable range of mechanical experience, and to cultivate habits both of logical thinking and of accurate work. The exercises involve some wood turning, pattern making, filing, scraping, sawing, punching, riveting, brazing, metal turning, shaping, planing, milling, grinding, etc. These exercises are guided by assigned readings, blue-printed instructions and by lectures on mechanical princi-

ples and processes, with occasional written work. Open to all students. Two shop periods each week. Two semester hours for one semester, to be taken in either semester.

Ordinarily it is expected that an engineering student will take Engineering A1 in one semester and Engineering A2 in the other semester of his freshman year.

Engineering B1. Sophomore Shop Work—This is a more intensive course than Engineering A2, limited mainly to pattern work, machine work, and tool making. The work is upon problems rather than exercises, and in them the student is given an opportunity to show his ingenuity and his grasp of the subject; while his work is directed in a general way, he is not given detailed instructions. The objects made are generally parts of some machine; this emphasizes the need for accuracy and gives a practical turn and interest to the subject. The work naturally introduces the student to a somewhat advanced knowledge of machines and processes. Open to students who have completed Engineering A2. One shop period each week. One semester hour throughout the year.

Engineering B2. Surveying—The use of chains, tapes, compass, level, transit, and plane table; methods of land, topographic and hydrographic surveying, including stream measurement, mine surveying and city surveying. Text-book: Theory and Practice of Surveying, by J. B. Johnson and L. S. Smith. Open to students who have completed Engineering A1 and Mathematics A3. Two recitations and one field period each week. Three semester hours throughout the year.

Engineering B3. Summer Surveying—Applications under actual field conditions of the theory taught in Engineering B2. The outcome of the work will be a map of the region covered by the survey and much allied information. A new area will be covered each year, ordinarily adjacent to the area surveyed in the preceding year. Six weeks immediately following commencement. Open to students who have completed Engineering B2. Credit six semester hours.

Engineering C1. Descriptive Geometry, Kinematics and Graphical Statics—The course is divided into three equal parts: (1) Descriptive Geometry; first principles; point, line and plane. Text-book: Essentials of Descriptive Geometry, by Phillips and Millar. (2) Kinematics; elementary propositions; communication of motion by rolling and sliding contact, by link work, by wrapping connectors. Text-book: Elementary Mechanism, by Stahl and Woods. (3) Graphical Statics; general principles; concurrent and non-concurrent forces; moments; roof trusses; loads; reactions; stresses; wind load stresses; cantilever and unsymmetrical trusses. Text: Graphic Statics, by Malcolm. Open to students who have completed Engineering A1 and Mathematics A3. One recitation period and two drawing periods each week. Three semester hours throughout the year.

Engineering D1. Contracts and Specifications—The course deals with contracts and specifications as applied to engineering only. Recitations and lectures. Text-book: The Law of Contracts, by John C. Wait. Open to students who have sixty hours of credit. Two semester hours in the second semester only.

Engineering D2. Journal Meeting—The time is spent in reading and reviewing current engineering literature, the object being to acquaint the student with this fund of information, to show him the necessity of judicious selection from the great mass of such current literature, to indicate methods of selection, and to cultivate a habit of accurate reading. Open to students who have taken or who are taking Engineering D3, D4, D5, or D6. One laboratory period each week. One semester hour throughout the year.

Engineering D3. Structural Mechanics—The text-book work is upon the application of mechanics to the elementary parts of structures, taking up properties of materials, testing materials, elementary theory of elasticity, stresses and strains of beams, columns, shafts, tubes, curved bars, springs and bodies in rapid rotation; stability of piles and retaining walls; elementary theory of reinforced concrete. The laboratory work relates partly to standard methods of testing materials such as steel and cement, but it is largely involved in an effort to bring to the clear comprehension of the student the various relations deduced in the text-book work upon the subject. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering D4. Heat Engines—A course in prime movers and general power plant equipment. Elementary thermodynamics. Construction and operation of steam engines, turbines and gas engines. Engine testing. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours in the second semester only. Not given in 1919-20.

Engineering D5. Electrical Machinery—A course in Direct and Alternating Current Machines. Special emphasis is placed upon the study of the fundamental principles involved and upon the application of these principles in practise. Open to students who have completed Mathematics B1 and who are taking Physics C1. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering D6. Electrical Engineering—First semester—A general study of the fundamental principles of Electrical Engineering and their applications to direct current machinery. Problems are assigned to illustrate quantitatively the principles involved. Second semester—A general study of the fundamental principles of single and polyphase alternating currents, with special reference to analytic and graphic methods of treatment. Elementary analysis of alternating current machinery. Open to students who have completed Mathematics B1 and who are taking Physics C1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E1. Thermodynamics—The course consists of text-book work first upon the general theory of thermodynamics, and later upon its application to heat engines, taking up properties of gases, flow of gases, thermodynamics of air engines, internal combustion engines and air compressors, properties of steam and other

vapors, thermodynamics of steam engines and steam turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Three semester hours in the first semester only. Not given in 1919-20.

Engineering E2. The Public Relations of Engineers—A course of lectures and reading dealing with the relations of a practising engineer to other men. It will deal in part with biographies of engineers, the history of engineering, the purpose of organization and the conservation of natural resources. Open to students who have taken or who are taking Engineering E1, E3, E4, E5, E6, E8 or E9. Two semester hours in the second semester only.

Engineering E3. Engines—A detailed study of the steam engine, steam turbine, boiler plant equipment, gas engines and producer gas plants. Open to students who have taken or who are taking Engineering E1. Two recitations and one laboratory period each week. Three semester hours throughout the year. Not given in 1919-20.

Engineering E4. Hydraulic Engineering—The theory and application of the principles of hydrostatics and hydrodynamics; measurements of flow by pressure gauges, meters, Pitot tubes and weirs; path, energy and impulse of jets; flow through orifices, tubes and pipes with loss of energy or head due to contractions, expansions and nozzles; derivation and application of formulæ for discharge, velocity and pressure; work derived from moving vanes as in water wheels and turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E5. Advanced Electrical Engineering—Advanced analysis by the analytic and graphic methods of treatment of continuous and alternating current machinery, of general alternating current and of transient phenomena. Lectures, assigned reading, recitations and laboratory work. Open to students who have completed Engineering D6. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering E6. Electric Power Plant Engineering—A study of the fundamental principles involved in the generation and transmission of electrical energy in large systems and in high potential systems. Emphasis is laid upon the proper relation of parts to form a complete plant. Lectures, assigned reading, recitations and laboratory work. Open to students who have completed Engineering E5. Two recitations and one laboratory period each week. Three semester hours in the second semester only.

Engineering E7. Thesis—Open to students in the last year in the Engineering course. Two semester hours in the first and four in the second semester in the Civil Engineering course and two in the first and three in the second in the Mechanical and Electrical Engineering course.

Engineering E8. Bridges—A general course on the theory and design of bridges, taking up stone arches, reinforced concrete arches, culverts and steel bridges of many types. Open to students who have completed Engineering D3. Three recitations and two drawing periods each week. Five semester hours in the second semester only.

Engineering E9. Structures—A general course on the theory and design of foundations, retaining walls, tall chimneys, masonry dams and building construction. Open to students who have completed Engineering D3. Three recitations and two drawing periods each week. Five semester hours in the first semester only.

Engineering E10. Railroad Engineering—The use of the transit, chain, level, etc., in laying out simple, compound and vertical curves; methods of reconnaissance, preliminary and location surveys; turnouts, switches and wye tracks; profile and cross section surveys, and computation of earthwork; haul and mass diagrams; maps and drawings; the use of topographic surveys in location; drainage, waterways and bridge staking. Economic theory of railway location, construction, extension and maintenance. Field work consists of laying out a short line and of the practical application of methods of staking, computation and mapping given above. Open to students who have completed Engineering B2 and Mathematics B1. Three recitations and one field period each week. Four semester hours in the first semester only.

Engineering E11. Advanced Mechanics—A study of the fundamental theory of structures and of certain structural members and machine elements common in mechanical and electrical engineering.

General Regulations

REGISTRATION

Every student is required to register in person at the office of the Registrar, College of Engineering, before entering upon college work, on the registration days specified in the calendar. Returning students who register after the close of this period are subject to a fee of two dollars.

On the registration days of the first semester the student must register for the work of the whole year. Changes may be made only with the consent of the Director. A course dropped without consent is regarded as a failure and is so recorded.

At the time of registration the student obtains from the Registrar his bill for tuition and fees for the semester. This should be paid at the Business Manager's Office within two weeks, otherwise a fee of $2.00 is added for late payments.

CLASSIFICATION

Students in the College of Engineering are grouped in five classes according to their credits in the office of the Registrar. The basis for their classification is as follows:

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first four years, and who have satisfied all entrance requirements, are classed as fifth year students.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first three years, and who have satisfied all entrance requirements, are classed as seniors.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first two years, and who have satisfied all entrance requirements, are classed as juniors.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first year, and who have satisfied all entrance requirements, are classed as sophomores.

All other regular students are classed as freshmen, without regard to the date of admission.

GRADES OF SCHOLARSHIP, EXAMINATIONS, AND ATTENDANCE

In other matters of student regulation, such as examinations, grades of scholarship, class and chapel attendance, and physical training, the students of the College of Engineering are governed by the regulations stated in the general University Catalog and in the Undergraduate's Manual.

FEES AND EXPENSES

Matriculation Fee, paid by each student when he first enters the University	$ 5.00
Tuition and Incidentals, per year, except for Fifth Year students	150.00
Tuition and Incidentals, per year, for Fifth Year students	50.00

Tuition and Incidentals are payable one-half at the beginning of the first semester, one-half at the beginning of the second.

Laboratory Fees.

Engineering A1	$ 3.00 a semester
Engineering A2	8.00 a semester
Engineering B1	4.00 a semester
Engineering B2 or D3	5.00 a semester
Engineering C1, D4, D5, D6, E3, E4, E5, E6, E8, E9 or E10	3.00 a semester
Student Enterprise Fee	2.50 a semester
Fee for summer surveying course, Engineering B3	15.00
Diploma Fee	10.00

The average cost to a student of engineering for the first four years, of all tuition and fees, as enumerated above, is about $172 per year.

The laboratory fees for engineering courses are intended to cover ordinary depreciation of apparatus and the use of materials. The student is held responsible for any damage due to his negligence.

Laboratory fees are not refunded if the student continues in a course as long as two weeks.

The tuition fees will not be refunded except in case of sickness. If a student withdraws before the middle of the semester, on account of serious illness, one-half of his tuition fee will be refunded, on his obtaining from the Director a statement of honorable standing, and from a physician a certificate that his health will not permit him to remain in attendance. The student will also be required to return his receipted bill for tuition.

Reduced rates of tuition are given to sons of clergymen who are actively pursuing the work of the ministry ($45.00 per semester). Holders of old-time perpetual or transferable scholarships are given free tuition.

The remaining necessary expenses of a student, namely, board, room, laundry, text-books and stationery, for nine months, vary from $280 to $460, the average being about $360 in normal times. In 1919-1920 these expenses will necessarily be higher on account of the post war conditions.

DORMITORIES

A new system of thirteen dormitories for men students is now in use. Nine of these buildings are designed for fraternities, whose alumni have contributed toward their cost, and the remaining four are open for rental by any of the men students of the University.

The buildings are architecturally beautiful and are meant to be models in comfort and sanitation. They are fireproof, lighted by electricity, and heated by steam. On the first floor of each building is a large enclosed porch, and a well equipped club room with an open fire-place, rugs, tables, and lounging chairs. There are also a few rooms for individual students on this floor. The second and third floors are made up entirely of single rooms.

Each student's private room is furnished with a single bed, mattress and pillow, a chiffonier, a combined study table and bookcase, two chairs, a rug, and window shades. The student furnishes his own bedding and towels, but the University takes charge of the laundering of these. In the interest of economy, electric lighting is not included in the general charge, but is apportioned pro rata monthly to the occupants of the building.

In the men's dormitories room rent is payable at the beginning of each semester and the charge to each student for the use of a furnished single room, including care, heat and water, varies from ninety to one hundred and ten dollars a year. The rental for private rooms on the first floor is somewhat higher.

The Registrar of the College of Liberal Arts is the renting officer of the dormitories; and men of the College of Engineering not living at their homes or in fraternity houses are required to live in the dormitories unless no rooms are available, or they obtain through the Registrar written permission to room elsewhere. Blank application forms for such permission will be furnished on request.

A chart showing the location and rental prices of rooms may be had from the Registrar upon application.

SCHOLARSHIPS

A few scholarships, worth $120 each, are awarded annually (five in 1919-1920) to select members of the incoming class, upon applications endorsed by the principal and faculty of the secondary school from which the applicant graduates. The applicant must meet the full entrance requirements and must present certificates from the teachers in his secondary school for excellence of character and scholarship, for physical vigor, manliness and promise of usefulness as a citizen. The award is made at the University by a committee of the College faculty.

A few scholarships, worth $120 each, are awarded annually (four in 1919-1920) to select members of the upper classes.

The upper class scholarship, worth $150, and known as the *Swift Scholarship*, has been given by Mrs. Gustavus F. Swift to members of the upper classes.

OPPORTUNITIES FOR SELF-HELP

Some students in Evanston have been able, while in college, to earn the cost of their living in full, and every year a large percentage earn a considerable portion of their expenses, and at the same time maintain a high standing in their studies. It is never advisable, however, for a student to undertake more work of this kind than is necessary for his personal support, and if the amount is excessive he should plan to give more than the normal five years to his college course.

The General Secretary of the Young Men's Christian Association maintains a bureau to assist students in finding employment. The positions most frequently open to young men are those as waiters at boarding places or as attendants in private houses in the care of gardens or furnaces. While the aggregate of the annual earnings of students is a large sum, the number of positions open is limited and no assurances can be given that employment will be found. Only the most faithful and self-reliant students should undertake self-support, and in no case should a student come to Evanston without sufficient means to meet expenses for at least a half-year.

RELIGIOUS AND SOCIAL LIFE OF STUDENTS

The charter of the University provides that "no particular religious faith shall be required of those who become students of this institution." Students are expected to attend public worship on Sunday in the church of their choice. Chapel service is held at ten o'clock on each week day, except Saturday, throughout the college year. Attendance upon at least two-fifths of these services is required. Under the direction of the Young Men's Christian Association religious meetings are held each week.

In athletics, in social life and in the use of the buildings, there is no separation of the students of Engineering from the students of Liberal Arts. Engineering students go to the various buildings of the College of Liberal Arts for recitations in other than strictly engineering subjects. They share in the use of the University Library. They have free access to the new gymnasium, the largest in the United States. Their social life is mingled with that of the Liberal Arts students in one university group.

The Engineering Society, composed of students of engineering and members of the engineering faculty, provides numerous addresses by prominent engineers and organizes inspection trips to points of engineering interest. The members also furnish many additional programs so that the society holds a meeting nearly every week.

An Engineering Assembly, attended by all students of engineering and by the engineering faculty, occurs eight times during each year. The general purpose of these assemblies is to develop a group consciousness in the students of engineering and to bring forward matters of especial interest to the group.

Some Advantages of the College of Engineering at Northwestern University

It offers a thorough professional course rather than a purely practical course. It places the emphasis on the fundamentals which are common to all branches of engineering. It trains its graduates for unlimited growth as engineers and for possible leadership.

The engineering courses, five years in length, are so arranged as to give each man his general broad training at the same time that he pursues his engineering studies. The engineering students are closely associated with the larger group of Liberal Arts students, of which they, in fact, form a part.

In the purely engineering part of the course, the proportion of professors to students is much larger than is customary and each student, therefore, receives an unusual amount of attention.

There is more engineering in progress within fifty miles of the loop district of Chicago than in any area of the same size anywhere in the United States with the possible exception of New York City. The students of this College thus have an unsurpassed opportunity to keep in touch with engineering practise and to meet engineers.

The College of Engineering is a young organization in excellent condition to take advantage of the experience of other colleges in training engineers.

It is provided with ample shop and laboratory equipment, selected with unusual care and deliberation, purely for teaching purposes and housed in an excellent building.

Inquiries for further information, requests for the catalog of the University, for scholarship application blanks, and for blank forms of certificates from secondary schools may be addressed to John F. Hayford, Director, College of Engineering, Northwestern University, Evanston, Illinois.

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1851

Northwestern University

Evanston — Chicago

¶ THE COLLEGE OF LIBERAL ARTS, in Evanston, offers well organized courses for general education, with special preparation for the professions and for other pursuits requiring broad training.

¶ THE GRADUATE SCHOOL, in Evanston, extends non-professional training and research beyond the College curriculum, with courses leading to advanced degrees.

¶ THE MEDICAL SCHOOL, in Chicago, is one of the best equipped in the United States and its reputation for efficiency is well-established. Numerous hospitals in close proximity are open to students. Clinical material is abundant.

¶ THE LAW SCHOOL, in Chicago, offers unexcelled library and research facilities. Its courses leading to degrees prepare for practice in any state.

¶ THE COLLEGE OF ENGINEERING, on the campus in Evanston, offers a five-year course of technical training in a University environment, leading to the degrees of Bachelor of Science and Civil Engineer or Electrical Engineer.

¶ THE DENTAL SCHOOL, in Chicago, is recognized as one of the leading schools for dental training and investigation. Its clinical facilities are unsurpassed.

¶ THE SCHOOL OF MUSIC in three well-equipped buildings offers exceptional advantages for the thorough study of music, professional or otherwise. It is located in Evanston.

¶ THE SCHOOL OF COMMERCE, in Chicago and Evanston, offers professional and scientific education for business with emphasis on the training of business executives. Day and evening work, laboratory courses, and business research.

¶ THE SCHOOL OF ORATORY, in Evanston, is unique in having university relations. It offers a well arranged course in interpretative literature, and a special course in Physical Education for teachers.

For information regarding any School of the University, address the President's Office, Northwestern University Building, Chicago, Illinois.

NORTHWESTERN University Bulletin is published weekly by Northwestern University during the academic year at Chicago, Illinois. Entered as second class mail matter November 21, 1913, at the post office at Chicago, Illinois, under act of Congress of August 24, 1912.

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Northwestern University Bulletin

COLLEGE *of* ENGINEERING ANNOUNCEMENTS
1920-1921

Published Weekly by Northwestern University
Northwestern University Building
CHICAGO

Vol. XXI, No. 7 August 14, 1920

NORTHWESTERN UNIVERSITY

Special Advantages of the College of Engineering

A thorough professional course rather than a purely practical one, with five years of broad training.

Small classes in which each student receives an unusual amount of individual attention.

A splendid building designed for the purpose, and up-to-date apparatus carefully selected to promote effective teaching.

Accessibility to great engineering projects, with unsurpassed opportunities to meet engineers and keep in touch with engineering practice.

A young thriving college in an old university.

Northwestern University Bulletin

COLLEGE *of* ENGINEERING ANNOUNCEMENTS
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August, 1920

SWIFT HALL OF ENGINEERING

Swift Hall of Engineering, the gift of Mrs. Gustavus F. Swift and her son, Edward F. Swift, was dedicated in 1909. The building measures fifty-eight by one hundred and twenty-six feet; the exterior is of Bedford limestone, and presents architectural lines that are of the best; the interior is a model of appropriate decoration, convenience, safety and strength; it has concrete floors and stairways throughout. It presents five working stories, all well lighted and of good height, and the large rooms at the ends of the building are free from columns. From the beginning, it was especially planned as the home [illegible] overlooking Lake Michigan.

Faculty

LYNN HAROLD HOUGH, Th.D., D.D.
President

JOHN FILLMORE HAYFORD, C.E., Sc.D.
Director

OLIN HANSON BASQUIN, Ph.D.
Professor of Applied Mechanics

WILLIAM CHARLES BAUER, B.S., Sc.D.
Professor of Electrical Engineering

HERBERT SHAW PHILBRICK, B.A., B.S.
Professor of Mechanical Engineering

WILLIAM HENRY BURGER, B.S.
Professor of Civil Engineering

....

Associate Professor of Drawing

....

Assistant Professor of Shop Work

HENRY CREW, Ph.D.
Professor of Physics

ULYSSES SHERMAN GRANT, Ph.D.
Professor of Geology

HORACE SECRIST, Ph.D.
Professor of Economics

DAVID RAYMOND CURTISS, Ph.D.
Professor of Mathematics

WILLIAM FRANK BRYAN, Ph.D.
Associate Professor of English

WINFORD LEE LEWIS, Ph.D.
Professor of Chemistry

ELTON JAMES MOULTON, Ph.D.
Associate Professor of Mathematics

HENRY ANDREWS BABCOCK, Ph.D.
Associate Professor of Physics

FREDERICK LAIRD KERR, M.A.
Registrar

VIVIEN K. RATHBUN
Assistant Registrar

ANDREWS ALLEN, C.E.
Lecturer on Contracts and Specifications

ELMER MARTIN LEESMAN, LL.B.
Lecturer on Contracts and Specifications

……………………………………………
Shop Assistant

Calendar

1920-1921

1920

Sept. 20	Mon.	Academic year 1920-1921 begins; examinations for admission; first day of registration
Sept. 23	Thu.	Class work begins
Nov. 25	Thu.	Thanksgiving Day
Dec. 18	Sat.	Christmas Recess, to January 3, Monday, inclusive

1921

Jan. 4	Tue.	Class work resumed
Jan. 24	Mon.	Mid-year examinations begin
Feb. 3	Thu.	Second semester begins; class work resumed
Mar. 24	Thu.	Easter Recess, to March 29, Tuesday, inclusive
May 30	Mon.	Regular examinations begin
June 15	Wed.	SIXTY-THIRD ANNUAL COMMENCEMENT
June 16	Thu.	Beginning of summer surveying
July 27	Wed.	End of summer surveying

Historical Note

THE charter of Northwestern University was signed by the Governor of Illinois on January 28, 1851. The corporation consists of forty-two trustees. An amendment to the charter provides that no intoxicating liquors shall be sold within four miles of the University.

The trustees selected as the seat of the University a tract of land on the shore of Lake Michigan, twelve miles north from the heart of Chicago. Here in 1855 the first University building was erected and about its location has grown up the City of Evanston. Here are the College of Liberal Arts, the College of Engineering, the School of Music, and the School of Oratory. The schools of Medicine, Law, Dentistry and Commerce are located in the City of Chicago.

The College of Liberal Arts, the oldest department of the University, was opened to students in the fall of 1855. From its small beginning it has grown, not by rapid expansion or by large benefactions, but by steady gains along conservative lines—each of its sixty years adding some improvements to its physical and educational equipment. The work of the College of Liberal Arts is mainly directed toward furnishing opportunities for a liberal culture or general education. The regulations affecting the choice of studies are such that the student may elect a large part of his work along lines in which he is especially interested.

In recent years a demand for instruction in engineering gradually made itself felt. A gift for the erection of an engineering building at Evanston and for its endowment led the Trustees of the University to take action in June, 1907, resulting in the establishing of a College of Engineering. This gift came from Mrs. Gustavus F.

Swift and her son, Edward F. Swift. The building, known as the Swift Hall of Engineering, was dedicated in May, 1909. It is now occupied by the College of Engineering. The Department of Mathematics of the College of Liberal Arts also has offices and recitation rooms in the building.

In 1919-1920, the College of Engineering had a total registration of one hundred and thirty-one students.

STATEMENT OF PURPOSE

The purpose of the College of Engineering of Northwestern University is to furnish to each student a thorough training for the profession of engineering, combined with a general training of the man. The College aims to train engineers for the greatest average effectiveness in a lifetime rather than for the greatest effectiveness in the first year after graduation. It aims to develop a capacity for unlimited growth. Hence strong emphasis is laid on those studies which tend to develop the man as well as on those which furnish training in engineering.

In keeping with these ideals, the courses in engineering introduce an unusual number of those non-technical studies that serve to give a general education and to develop the thinking power of the students. Unusual stress is laid upon Mathematics, upon Physics and other sciences fundamental to engineering and upon the principles which are broadly applicable to all engineering. The courses are five years in length, because past experience among colleges of engineering shows that four years is too short a time for the thorough professional training contemplated. At the end of four years the student of engineering will have secured as thorough a general training as one who comes to Northwestern University for general training alone. In recognition of that fact, he will be given the degree of Bachelor of Science by the College of Liberal Arts. During the fifth year the general training of the student is continued and he completes his professional course in engineering.

The motto of the College is "Culture for Usefulness." This motto calls for an effort to obtain for the student the broadest

culture attainable in five years in order to equip him, as a man and as an engineer, for the greatest possible usefulness in the world in the united struggle of man for progress.

Requirements for Admission

Candidates for admission without entrance conditions must qualify by examination or by certificate on fifteen units of High School work. The unit is a course of study requiring a daily recitation on a prepared topic for a full school year, and covering in the various subjects the work defined in the University Catalog.

English, three units; Algebra, one and a half units; and Plane Geometry, one unit, are required of all candidates. A choice is allowed in the selection of other subjects, but the choice must include either four units of foreign language or two units of foreign language plus two units chosen from the following group: College Algebra one-half unit, Plane Trigonometry one-half unit, Solid Geometry one-half unit, Physics one unit, Chemistry one unit, Manual Training one or two units, and Mechanical Drawing one or two units. The choice of foreign language is limited to Latin, Greek, French, German and Spanish and a certain maximum number of units in each as indicated in the table which follows. A single unit of any language will be accepted to meet the specific foreign language requirement only when accompanied by at least three units of some other language or two units each of two others. The remaining five and one-half units required to make an aggregate of fifteen units may include any subjects commonly appearing as a part of a high school course, provided that no subject is presented for less than a half unit of credit. Vocal music and physical training are not recognized for credit.

The following table indicates the subjects commonly presented for admission credit:

Latin	2, 3 or 4	units
Greek	2 or 3	units
German	2 or 3	units
French	2 or 3	units
Spanish	2	units
College Algebra	½	unit
Plane Trigonometry	½	unit
Solid Geometry	½	unit
Physiography	1	unit
Physics	1	unit
Botany	1	unit
Zoology	1	unit
Chemistry	1	unit
Ancient History	1	unit
Mediæval and Modern History	1	unit
English History	1	unit
American History (or with Civil Government)	1	unit
Civil Government	½	unit
Political Economy	½	unit
Commercial Geography	½	unit
Commercial Law	½	unit
Physiology	½	unit
Mechanical Drawing	1 or 2	units
Manual Training	1 or 2	units

One unit of entrance credit in Mechanical Drawing may be given for twelve hours work per week for a full school year, or an equivalent amount of time, provided the work is of an acceptable character. A second unit of credit may be given in Mechanical Drawing only in case the course in drawing taken in school covers the full equivalent of the course Engineering A1 of the College of Engineering.

One unit of entrance credit in Manual Training may be given for twelve hours work per week for a full school year, or an equivalent amount of time, provided the work is of an acceptable character. A second unit of credit may be given in Manual Training only in case the course in Manual Training taken in school covers the full equivalent of the course Engineering A2 of the College of Engineering.

For a statement in detail of the definitions of other entrance units consult the Catalog of the University.

Each student in engineering who has not presented Solid Geometry for entrance will be required to take Solid Geometry, three hours for one semester, in the first year. As this will be an extra task,

making it difficult for the student to keep up with his class, each candidate is advised to present this subject for entrance if possible.

So, too, there are various other ways in which a student in meeting the entrance requirements may by his selection of the subjects presented either lighten his later college work, or may so handicap himself as to make it difficult to secure an engineering degree in five years. For a general suggestion on this point, consult page 14.

A candidate may be admitted to the College of Engineering as a regular student with not more than two units of condition, but entrance conditions, if any, must be made up during the first year of residence.

Admission to the College of Engineering may be by certificate or by examination. Candidates for admission must be at least sixteen years of age. Graduates of academies or high schools should obtain certificates of work done, showing the ground covered and the grade received in each study. These certificates should be sent to the Registrar, College of Engineering, at least one week before the opening of the fall semester. It is advisable to send them in much earlier. Certificate blanks may be had on request. Candidates who cannot present such certificates may be admitted on examination. Examinations for this purpose will be held September 20, 1920.

ADVANCED STANDING

Students from other colleges seeking admission to this college must present evidence of honorable dismissal from the institution last attended and must present certificates showing (1) a full record of the applicant's preparation for college, (2) his college record, subject by subject, with the grade obtained in each subject and the year of the course in which it was taken. He should submit a catalog of his college, bearing his name, and of the issue current at the time of his admission to that college. Students from other colleges must first meet the entrance requirements to this college, after which the amount of advanced credit to be obtained by certificate will be estimated by a committee of the Faculty, but not finally placed to

his credit until the student has been in residence in this college for one semester. Advanced credit without examination will be given only for work done in an approved college. Claims for advanced credit must be made during the first year of residence and not later than September of the collegiate year in which the candidate expects to graduate.

College credit for work done in a secondary school in excess of the requirements for admission can be given only on examination provided through the Registrar's office, and on the basis of five semester hours of credit for one unit of work. An exception to the examination rule is made in foreign language subjects continued in college during the first year, where the subsequent work is a sufficient test of the quality of the earlier work. Applications for such credit and for examination must be made to the Registrar during the first semester of residence and the examination must be taken at one of the regular dates set, viz.: the Wednesday of the opening week in September, or the Saturday following regular examinations in February. Advanced credit can be allowed only in Mathematics, foreign languages, or such other subjects taken in the last year of the secondary school course as may be approved by the Committee on Advanced Standing. No examination for advanced credit will be allowed after the first year of residence nor in subjects foreign to the college curriculum.

Courses of Study

The College of Engineering offers two courses of study, each five years in length, one in Mechanical and Electrical Engineering and the other in Civil Engineering. These courses are alike in character and the same in content to the end of the third year.

For the satisfactory completion of the first four years of either course, the degree, Bachelor of Science, will be given by the College of Liberal Arts.

The degree, Electrical Engineer, will be given by the College of Engineering at the end of the five-year course in Mechanical and Electrical Engineering, and the degree, Civil Engineer, at the end of the five-year course in Civil Engineering.

COURSE IN MECHANICAL AND ELECTRICAL ENGINEERING

	Semester Hours	
	First Semester	Second Semester
Freshman Year		
Mechanical Drawing, Engineering A1, or Shop Work, Engineering A2	2	..
Shop Work, Engineering A2, or Mechanical Drawing, Engineering A1	..	2
Mathematics A3	5	5
English A1	3	3
French A	3	3
Chemistry A	4	4
Summer Work	..	2
Sophomore Year		
Calculus, Mathematics B1	3	3
Physics A1	4	4
German A	3	3
Surveying, Engineering B2	3	3
Shop Work, Engineering B1	1	1
English B1	2	2
Summer Surveying, Engineering B3	..	6

	Semester Hours	
	First Semester	Second Semester
Junior Year		
Physics B1	3	3
Descriptive Geometry, Kinematics, and Graphical Statics, Engineering C1	3	3
Chemistry B1	5	..
Geology A1	5	..
*Chemistry B2	..	5
*Geology A3 or Geology B9	..	4
Economics A	..	5
Summer Work	..	2
Senior Year		
Physics C1	3	3
Electrical Engineering, Engineering D6	3	3
Structural Mechanics, Engineering D3	3	3
Mathematics C1	5	..
Elective	..	5
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Summer Work	..	2
Fifth Year		
Advanced Electrical Engineering, Engineering E5	3	..
Electric Power Plant Engineering, Engineering E6	..	3
Thermodynamics, Engineering E1	3	..
Engines, Engineering E3	3	3
Hydraulic Engineering, Engineering E4	3	3
The Public Relation of Engineers, Engineering E2	..	2
Elective	3	..
Advanced Mechanics, Engineering E11, or Elective	..	3
Thesis, Engineering E7	2	3

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*The student may omit either Chemistry B2 or the second semester of Geology.

COURSE IN CIVIL ENGINEERING

The first three years of this course are the same as those in the course in Mechanical and Electrical Engineering.

	Semester Hours First Semester	Second Semester
Senior Year		
Physics C1	3	3
Structural Mechanics, Engineering D3	3	3
Mathematics C1	5	..
Elective	..	5
Electrical Machinery, Engineering D5	3	..
Heat Engines, Engineering D4	..	3
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Summer Work	..	2
Fifth Year		
Structures, Engineering E9	5	..
Bridges, Engineering E8	..	5
Hydraulic Engineering, Engineering E4	3	3
Railroad Engineering, Engineering E10	4	..
The Public Relations of Engineers, Engineering E2	..	2
Elective	3	3
Thesis, Engineering E7	2	4

Each course may be taken precisely as shown above by a student who enters the College with the standard preparation which includes English three units, Algebra one and one-half units, Plane Geometry one unit, Solid Geometry one-half unit, French two units, and German two units. If however the student enters College deficient in any of the subjects enumerated in the preceding sentence and the deficiency is not counterbalanced by excess elsewhere in his preparation of the character indicated later in this paragraph, it will

be impossible for him to complete either engineering course in five years without securing more than an average of seventeen semester hours of credit in each semester. Only an exceptionally strong student may expect to secure more than seventeen hours of credit per semester. Certain subjects when accepted for entrance credit constitute an excess in the sense that they relieve the student offering them of some college work which would otherwise be required of him in the engineering courses. These are College Algebra, Plane Trigonometry, Chemistry, a second unit of Mechanical Drawing, a second unit of Manual Training, and such preparation in foreign language as will leave the student less than twelve semester hours of foreign language to be taken in college in order to meet the requirements for the degree of Bachelor of Science which are shown in the Catalog of the University. As an example it may be stated that a student who presents three units of German or Latin, and two of French, is required to take in college French A only, six semester hours, instead of both French A and German A as listed above, twelve semester hours.

For recitations or lectures one semester hour of credit is given for one period, fifty minutes, each week, during one semester. For shop work, drafting or laboratory work, one semester hour of credit is given for one three-hour period each week during one semester.

REQUIRED SUMMER WORK

During each of the three summers following the first, third and fourth years the student is required to do practical work for at least six weeks, of such a character as to furnish experience of value to him as a prospective engineer. The credit assigned to six weeks of such approved work is two semester hours.

Under this requirement, students have acted as rodmen on city surveys, rodmen on the United States Lake Survey, workers in the tool room of a factory, helpers in the installation of heavy machinery in a new steam-electric power plant, foremen of gangs of laborers, helpers in the wiring of telephone switchboards, assistants in cement testing, computers for the Carnegie Institution, inspectors with a

company engaged in electric lighting and power distribution, and have worked on milling and machine work, figuring estimates, making tracings, and on land and topographical surveys.

During the summer following the second year the student is required to do field work in surveying for six weeks immediately following commencement, Engineering B3, credit six semester hours. This is a regular college course under the direction of college professors.

DESCRIPTION OF COURSES

The following paragraphs give more specific information in regard to the separate courses enumerated above as together constituting the courses in Mechanical and Electrical Engineering and in Civil Engineering.

English A1. Composition and Rhetoric; Brief Survey of English Literature—Required of all students in their first year. Three semester hours throughout the year.

English A2. Composition and Rhetoric—Required of students whose preparation is found to be insufficient for English A1. The work of the first semester is continued two hours a week in the second semester and attendance is required until the student's work is brought consistently up to a satisfactory standard.

French A. Modern French—Composition, conversation, and dictation. Three semester hours throughout the year. Open to students who present two units of French for entrance. If the student has presented no French for entrance he must take French AA, five semester hours throughout one year, in college before being admitted to French A, or if he has presented one unit of French for entrance, he must ordinarily take French AB, three semester hours throughout one year, in college before being admitted to French A.

German A. Intermediate German—Modern prose writers, classic drama and lyrics. Three semester hours throughout the year.

Open to students who present two units of German for entrance. If the student has presented no German for entrance he must take German AA, five semester hours throughout one year, in college before being admitted to German A, or if he has presented one unit of German for entrance he must ordinarily take German AB, three semester hours throughout one year, in college before being admitted to German A.

If the student has offered for entrance two units of French and two of German, he is advised to take French A in the first year and German A in the second year, but the order may be reversed. If other language units than those named in the preceding sentence have been offered for entrance, the student is required to take such language courses as will satisfy the language requirement for the degree of Bachelor of Science. These are not necessarily the courses French A and German A. For example, if a student has presented two or three units of Latin or of Greek for entrance he may be released, both as to entrance credits and as to college work, from a part of French or German. For complete information on this point, consult the statement of prescribed courses for the degree of Bachelor of Science, in the University catalog.

Mathematics A3. Plane Trigonometry, Algebra and Analytical Geometry—This is a course in which Plane Trigonometry, Algebra and Analytical Geometry are given together in one continuous course. Open to students who have presented one and a half units of Algebra for admission. Five semester hours throughout the year.

If a student has presented College Algebra or Plane Trigonometry for entrance, instead of taking Mathematics A3 in the freshman year, he is required to take three semester hours in each of two semesters in courses so arranged that with the work offered for entrance they will be equivalent to Mathematics A3.

Mathematics B1. Differential and Integral Calculus—A first course in Calculus, including its simpler applications. Open to students who have completed Mathematics A3, or an equivalent. Three semester hours throughout the year.

Mathematics C1. Advanced Calculus—Infinite series; Taylor's theorem; partial differentiation; differential geometry; definite integrals over curves, surfaces and volumes; the Eulerian functions; differential equations. Open to students who have completed Mathematics B1. Five semester hours in the first semester.

Physics A1. General Physics—First semester—General properties of matter, wave-motion, sound, heat. Second semester—Electricity, magnetism, light. An introductory course requiring no mathematics beyond the requirements for entrance to college, intended to acquaint the student with the elementary facts, the method, and the general principles of physical science. Text-book: Crew's General Physics. Three lectures and one laboratory exercise each week. Open to all students. Four semester hours throughout the year.

Physics B1. Mechanics—An elementary experimental study of forces, moments of force, moments of inertia, elasticity, hydromechanics, an introduction to advanced Physics and Engineering. This is a course in pure Dynamics, and serves as an introduction to Applied Mechanics. Two lectures and one laboratory exercise each week. The laboratory work is guided by specially prepared instructions. Open to students who have completed Physics A1, or its equivalent, and who have completed or are taking Mathematics B1. Three semester hours throughout the year.

Physics C1. Electricity and Magnetism—The more general laws of electricity and magnetism are discussed; the practical equations employed in the laboratory are derived and discussed. The laboratory work includes the measurement by one or more methods of current, resistance, electromotive force, temperature-coefficients, capacity; a study of the magnetic properties of iron and steel, thermoelectric effects, the use of the electrometer, the Carey Foster bridge, potentiometer, copper coulometer, etc. Open to students who have completed Mathematics B1 and who have completed or are taking Physics B1. Two lectures and one laboratory exercise each week. Three semester hours throughout the year.

Chemistry A1. General Chemistry—Text and laboratory work. Open to all students. Five semester hours throughout the year.

Chemistry A2. General Chemistry—Text and laboratory work. Open to students who present a year of high school chemistry for admission. Five semester hours throughout the year.

Chemistry B1. Qualitative Analysis—Analysis of simple mixtures accompanied by lectures and quizzes. Recitations and laboratory work. Open to students who have completed Chemistry A1 or A2. Five semester hours for one semester, to be taken in either semester. One semester hour is credited as an elective.

Chemistry B2. Organic Chemistry—Lectures and quizzes on the hydrocarbons and their derivatives. Laboratory preparation and study of typical organic compounds. Recitations and laboratory work. Open to students who have completed Chemistry B1 or an equivalent. Five semester hours for one semester, to be taken in either semester. One semester hour is credited as an elective.

Geology A1. General Geology—A general introduction to Geology. Lectures, recitations and laboratory work. Open to Sophomores, Juniors and Seniors. Five semester hours in the first semester only. One semester hour is credited as an elective.

Geology A3. Mineralogy—Crystallography, descriptive mineralogy, and determinative mineralogy of the common ores and rock forming minerals. Open to students who have completed in college or in high school a year course in Chemistry. Four semester hours in the second semester only.

Geology B5. Metallurgy—Fuels, refractory and cementing materials, metallurgy of iron and steel. Open to those students of Engineering who have completed Chemistry A. Two semester hours in the first semester only.

Geology B9. Historical Geology—A history of the earth, with special reference to the evolution of the North American Continent. Open to students who have completed Geology A1. Four semester hours in the second semester only.

Economics A. The Elements of Economics—An examination of the fundamental principles of economics, and the application of these principles to practical problems. Open to Sophomores, Juniors and Seniors. Five semester hours for one semester, to be taken in either semester.

English B1. Types of English Literature; Composition—Lectures, recitations, written reports and themes, and reading. Open to students who have completed the required English of the first year. Two semester hours throughout the year.

Electives—Five semester hours of electives are provided for in the senior year of both courses, and six in the fifth year. These electives are limited to courses given in the College of Liberal Arts, the choice to be approved by the Director, with the exception that Engineering E11 may be taken as an elective in the fifth year of the Mechanical and Electrical Engineering course.

Engineering A1. Mechanical Drawing—An elementary course in the technique of mechanical drawing, requiring no previous knowledge of drawing. Freehand lettering, exercise drawing, freehand sketching, shop drawing in pencil, tracing in ink on tracing cloth. Open to all students. Two drawing periods each week. Two semester hours for one semester, to be taken in either semester.

Engineering A2. Freshman Shop Work—A series of elementary practical exercises in the shop, upon a wide variety of subjects, the object being to bring out the principles involved, to acquaint the student with a considerable range of mechanical experience, and to cultivate habits both of logical thinking and of accurate work. The exercises involve some wood turning, pattern making, filing, scraping, sawing, punching, riveting, brazing, metal turning, shaping, planing, milling, grinding, etc. These exercises are guided by assigned readings, blue-printed instructions and by lectures on mechanical princi-

ples and processes, with occasional written work. Open to all students. Two shop periods each week. Two semester hours for one semester, to be taken in either semester.

Ordinarily it is expected that an engineering student will take Engineering A1 in one semester and Engineering A2 in the other semester of his freshman year.

Engineering B1. Sophomore Shop Work—This is a more intensive course than Engineering A2, limited mainly to pattern work, machine work, and tool making. The work is upon problems rather than exercises, and in them the student is given an opportunity to show his ingenuity and his grasp of the subject; while his work is directed in a general way, he is not given detailed instructions. The objects made are generally parts of some machine; this emphasizes the need for accuracy and gives a practical turn and interest to the subject. The work naturally introduces the student to a somewhat advanced knowledge of machines and processes. Open to students who have completed Engineering A2. One shop period each week. One semester hour throughout the year.

Engineering B2. Surveying—The use of chains, tapes, compass, level, transit, and plane table; methods of land, topographic and hydrographic surveying, including stream measurement, mine surveying and city surveying. Text-book: Theory and Practice of Surveying, by J. B. Johnson and L. S. Smith. Open to students who have completed Engineering A1 and Mathematics A3. Two recitations and one field period each week. Three semester hours throughout the year.

Engineering B3. Summer Surveying—Applications under actual field conditions of the theory taught in Engineering B2. The outcome of the work will be a map of the region covered by the survey and much allied information. A new area will be covered each year, ordinarily adjacent to the area surveyed in the preceding year. Six weeks immediately following commencement. Open to students who have completed Engineering B2. Credit six semester hours.

Engineering C1. Descriptive Geometry, Kinematics and Graphical Statics—The course is divided into three equal parts: (1) Descriptive Geometry; first principles; point, line and plane. (2) Kinematics; elementary propositions; communication of motion by rolling and sliding contact, by link work, by wrapping connectors. (3) Graphical Statics; general principles; concurrent and non-concurrent forces; moments; roof trusses; loads; reactions; stresses; wind load stresses; cantilever and unsymmetrical trusses. Open to students who have completed Engineering A1 and Mathematics A3. One recitation period and two drawing periods each week. Three semester hours throughout the year.

Engineering D1. Contracts and Specifications—The course deals with contracts and specifications as applied to engineering only. Recitations and lectures. Text-book: The Law of Contracts, by John C. Wait. Open to students who have sixty hours of credit. Two semester hours in the second semester only.

Engineering D2. Journal Meeting—The time is spent in reading and reviewing current engineering literature, the object being to acquaint the student with this fund of information, to show him the necessity of judicious selection from the great mass of such current literature, to indicate methods of selection, and to cultivate a habit of accurate reading. Open to students who have taken or who are taking Engineering D3, D4, D5, or D6. One laboratory period each week. One semester hour throughout the year.

Engineering D3. Structural Mechanics—The text-book work is upon the application of mechanics to the elementary parts of structures, taking up properties of materials, testing materials, elementary theory of elasticity, stresses and strains of beams, columns, shafts, tubes, curved bars, springs and bodies in rapid rotation; stability of piles and retaining walls; elementary theory of reinforced concrete. The laboratory work relates partly to standard methods of testing materials such as steel and cement, but it is largely involved in an effort to bring to the clear comprehension of the student the various relations deduced in the text-book work upon the subject. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering D4. Heat Engines—A course in prime movers and general power plant equipment. Elementary thermodynamics. Construction and operation of steam engines, turbines and gas engines. Engine testing. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours in the second semester only. Not given in 1919-20.

Engineering D5. Electrical Machinery—A course in Direct and Alternating Current Machines. Special emphasis is placed upon the study of the fundamental principles involved and upon the application of these principles in practise. Open to students who have completed Mathematics B1 and who are taking Physics C1. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering D6. Electrical Engineering—First semester—A general study of the fundamental principles of Electrical Engineering and their applications to direct current machinery. Problems are assigned to illustrate quantitatively the principles involved. Second semester—A general study of the fundamental principles of single and polyphase alternating currents, with special reference to analytic and graphic methods of treatment. Elementary analysis of alternating current machinery. Open to students who have completed Mathematics B1 and who are taking Physics C1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E1. Thermodynamics—The course consists of text-book work first upon the general theory of thermodynamics, and later upon its application to heat engines, taking up properties of gases, flow of gases, thermodynamics of air engines, internal combustion engines and air compressors, properties of steam and other

vapors, thermodynamics of steam engines and steam turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Three semester hours in the first semester only.

Engineering E2. The Public Relations of Engineers—A course of lectures and reading dealing with the relations of a practising engineer to other men. It will deal in part with biographies of engineers, the history of engineering, the purpose of organization and the conservation of natural resources. Open to students who have taken or who are taking Engineering E1, E3, E4, E5, E6, E8 or E9. Two semester hours in the second semester only.

Engineering E3. Engines—A detailed study of the steam engine, steam turbine, boiler plant equipment, gas engines and producer gas plants. Open to students who have taken or who are taking Engineering E1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E4. Hydraulic Engineering—The theory and application of the principles of hydrostatics and hydrodynamics; measurements of flow by pressure gauges, meters, Pitot tubes and weirs; path, energy and impulse of jets; flow through orifices, tubes and pipes with loss of energy or head due to contractions, expansions and nozzles; derivation and application of formulæ for discharge, velocity and pressure; work derived from moving vanes as in water wheels and turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E5. Advanced Electrical Engineering—Advanced analysis by the analytic and graphic methods of treatment of continuous and alternating current machinery, of general alternating current and of transient phenomena. Lectures, assigned reading, recitations and laboratory work. Open to students who have completed Engineering D6. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering E6. Electric Power Plant Engineering—A study of the fundamental principles involved in the generation and transmission of electrical energy in large systems and in high potential systems. Emphasis is laid upon the proper relation of parts to form a complete plant. Lectures, assigned reading, recitations and laboratory work. Open to students who have completed Engineering E5. Two recitations and one laboratory period each week. Three semester hours in the second semester only.

Engineering E7. Thesis—Open to students in the last year in the Engineering course. Two semester hours in the first and four in the second semester in the Civil Engineering course and two in the first and three in the second in the Mechanical and Electrical Engineering course.

Engineering E8. Bridges—A general course on the theory and design of bridges, taking up stone arches, reinforced concrete arches, culverts and steel bridges of many types. Open to students who have completed Engineering D3. Three recitations and two drawing periods each week. Five semester hours in the second semester only.

Engineering E9. Structures—A general course on the theory and design of foundations, retaining walls, tall chimneys, masonry dams and building construction. Open to students who have completed Engineering D3. Three recitations and two drawing periods each week. Five semester hours in the first semester only.

Engineering E10. Railroad Engineering—The use of the transit, chain, level, etc., in laying out simple, compound and vertical curves; methods of reconnaissance, preliminary and location surveys; turnouts, switches and wye tracks; profile and cross section surveys, and computation of earthwork; haul and mass diagrams; maps and drawings; the use of topographic surveys in location; drainage, waterways and bridge staking. Economic theory of railway location, construction, extension and maintenance. Field work consists of laying out a short line and of the practical application of methods of staking, computation and mapping given above. Open to students who have completed Engineering B2 and Mathematics B1. Three recitations and one field period each week. Four semester hours in the first semester only.

Engineering E11. Advanced Mechanics—A study of the fundamental theory of structures and of certain structural members and machine elements common in mechanical and electrical engineering.

General Regulations

REGISTRATION

Every student is required to register in person at the office of the Registrar, College of Engineering, before entering upon college work, on the registration days specified in the calendar. Returning students who register after the close of this period are subject to a fee of two dollars.

On the registration days of the first semester the student must register for the work of the whole year. Changes may be made only with the consent of the Director. A course dropped without consent is regarded as a failure and is so recorded.

At the time of registration the student obtains from the Registrar his bill for tuition and fees for the semester. This should be paid at the Business Manager's Office within two weeks, otherwise a fee of $2.00 is added for late payments.

CLASSIFICATION

Students in the College of Engineering are grouped in five classes according to their credits in the office of the Registrar. The basis for their classification is as follows:

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first four years, and who have satisfied all entrance requirements, are classed as fifth year students.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first three years, and who have satisfied all entrance requirements, are classed as seniors.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first two years, and who have satisfied all entrance requirements, are classed as juniors.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first year, and who have satisfied all entrance requirements, are classed as sophomores.

All other regular students are classed as freshmen, without regard to the date of admission.

GRADES OF SCHOLARSHIP, EXAMINATIONS, AND ATTENDANCE

In other matters of student regulation, such as examinations, grades of scholarship, class and chapel attendance, and physical training, the students of the College of Engineering are governed by the regulations stated in the general University Catalog and in the Undergraduate's Manual.

FEES AND EXPENSES

Matriculation Fee, paid by each student when he first enters the University and before his first registration is complete	$ 5.00
Tuition and Incidentals, per year, except for Fifth Year students	200.00
Tuition and Incidentals, per year, for Fifth Year students	50.00

Tuition and Incidentals are payable one-half at the beginning of the first semester, one-half at the beginning of the second.

Laboratory Fees.

Engineering A1	$ 3.00 a semester
Engineering A2	8.00 a semester
Engineering B1	4.00 a semester
Engineering B2 or D3	5.00 a semester
Engineering C1, D4, D5, D6, E3, E4, E5, E6, E8, E9 or E10	3.00 a semester
Student Enterprise Fee	3.00 a semester
Fee for summer surveying course, Engineering B3	15.00
Diploma Fee	10.00

The average cost to a student of engineering for the first four years of all tuition and fees, as enumerated above, is about $222 per year.

The laboratory fees for engineering courses are intended to cover ordinary depreciation of apparatus and the use of materials. The student is held responsible for any damage due to his negligence.

Laboratory fees are not refunded if the student continues in a course as long as two weeks.

The tuition fees will not be refunded except in case of sickness. If a student withdraws before the middle of the semester, on account of serious illness, one-half of his tuition fee will be refunded on his obtaining from the Director a statement of honorable standing and from a physician a certificate that his health will not permit him to remain in attendance. Application for a refund must be made before the close of a semester in which the fee was paid.

Reduced rates of tuition are given to sons of ordained ministers in active service, or retired and not engaged in business ($60.00 per semester).

Holders of old-time perpetual or transferable scholarships are given free tuition.

A duplicate transcript of credit, when there has been no change in the amount of credit on record, will be issued only on payment of $1.00.

The University is not responsible for the loss of personal property belonging to students in any building owned by the University, whether by theft, fire or unknown cause.

DORMITORIES

A new system of thirteen dormitories for men students is now in use. Nine of these buildings are designed for fraternities, whose alumni have contributed toward their cost, and the remaining four are open for rental by any of the men students of the University.

The buildings are architecturally beautiful and are meant to be models in comfort and sanitation. They are fireproof, lighted by electricity, and heated by steam. On the first floor of each building is a large enclosed porch, and a well equipped club room with an open fire-place, rugs, tables, and lounging chairs. There are also a few rooms for individual students on this floor. The second and third floors are made up entirely of single rooms.

Each student's private room is furnished with a single bed, mattress and pillow, a chiffonier, a combined study table and bookcase, two chairs, a rug, and window shades. The student furnishes his own bedding and towels, but the University takes charge of the laundering of these. In the interest of economy, electric lighting is not included in the general charge, but is apportioned pro rata monthly to the occupants of the building.

In the men's dormitories room rent is payable at the beginning of each semester and the charge to each student for the use of a furnished single room, including care, heat and water, varies from ninety to one hundred and ten dollars a year. The rental for private rooms on the first floor is somewhat higher.

The Registrar of the College of Liberal Arts is the renting officer of the dormitories; and men of the College of Engineering not living at their homes or in fraternity houses are required to live in the dormitories unless no rooms are available, or they obtain through the Registrar written permission to room elsewhere. Blank application forms for such permission will be furnished on request.

A chart showing the location and rental prices of rooms may be had from the Registrar upon application.

SCHOLARSHIPS

A few scholarships, worth $120 each, are awarded annually (five in 1919-1920) to select members of the incoming class, upon applications endorsed by the principal and faculty of the secondary school from which the applicant graduates. The applicant must meet the full entrance requirements and must present certificates from the teachers in his secondary school for excellence of character and scholarship, for physical vigor, manliness and promise of usefulness as a citizen. The award is made at the University by a committee of the College faculty.

A few scholarships, worth $120 each, are awarded annually (four in 1919-1920) to select members of the upper classes.

The upper class scholarship, worth $150, and known as the *Swift Scholarship*, has been given by Mrs. Gustavus F. Swift to members of the upper classes.

OPPORTUNITIES FOR SELF-HELP

Some students in Evanston have been able, while in college, to earn the cost of their living in full, and every year a large percentage earn a considerable portion of their expenses, and at the same time maintain a high standing in their studies. It is never advisable, however, for a student to undertake more work of this kind than is necessary for his personal support, and if the amount is excessive he should plan to give more than the normal five years to his college course.

The General Secretary of the Young Men's Christian Association maintains a bureau to assist students in finding employment. The positions most frequently open to young men are those as waiters at boarding places or as attendants in private houses in the care of gardens or furnaces. While the aggregate of the annual earnings of students is a large sum, the number of positions open is limited and no assurances can be given that employment will be found. Only the most faithful and self-reliant students should undertake self-support, and in no case should a student come to Evanston without sufficient means to meet expenses for at least a half-year.

RELIGIOUS AND SOCIAL LIFE OF STUDENTS

The charter of the University provides that "no particular religious faith shall be required of those who become students of this institution." Students are expected to attend public worship on Sunday in the church of their choice. Chapel service is held at ten o'clock on each week day, except Saturday, throughout the college year. Attendance upon at least two-fifths of these services is required. Under the direction of the Young Men's Christian Association religious meetings are held each week.

In athletics, in social life and in the use of the buildings, there is no separation of the students of Engineering from the students of Liberal Arts. Engineering students go to the various buildings of the College of Liberal Arts for recitations in other than strictly engineering subjects. They share in the use of the University Library. They have free access to the new gymnasium, the largest in the United States. Their social life is mingled with that of the Liberal Arts students in one university group.

The Engineering Society, composed of students of engineering and members of the engineering faculty, provides numerous addresses by prominent engineers and organizes inspection trips to points of engineering interest. The members also furnish many additional programs so that the society holds a meeting nearly every week.

An Engineering Assembly, attended by all students of engineering and by the engineering faculty, occurs eight times during each year. The general purpose of these assemblies is to develop a group consciousness in the students of engineering and to bring forward matters of especial interest to the group.

Some Advantages of the College of Engineering at Northwestern University

It offers a thorough professional course rather than a purely practical course. It places the emphasis on the fundamentals which are common to all branches of engineering. It trains its graduates for unlimited growth as engineers and for possible leadership.

The engineering courses, five years in length, are so arranged as to give each man his general broad training at the same time that he pursues his engineering studies. The engineering students are closely associated with the larger group of Liberal Arts students, of which they, in fact, form a part.

In the purely engineering part of the course, the proportion of professors to students is much larger than is customary and each student, therefore, receives an unusual amount of attention.

There is more engineering in progress within fifty miles of the loop district of Chicago than in any area of the same size anywhere in the United States with the possible exception of New York City. The students of this College thus have an unsurpassed opportunity to keep in touch with engineering practise and to meet engineers.

The College of Engineering is a young organization in excellent condition to take advantage of the experience of other colleges in training engineers.

It is provided with ample shop and laboratory equipment, selected with unusual care and deliberation, purely for teaching purposes and housed in an excellent building.

Inquiries for further information, requests for the catalog of the University, for scholarship application blanks, and for blank forms of certificates from secondary schools may be addressed to John F. Hayford, Director, College of Engineering, Northwestern University, Evanston, Illinois.

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Northwestern University

Evanston — Chicago

¶ THE COLLEGE OF LIBERAL ARTS, in Evanston, offers well organized courses for general education, with special preparation for the professions and for other pursuits requiring broad training.

¶ THE GRADUATE SCHOOL, in Evanston, extends non-professional training and research beyond the College curriculum, with courses leading to advanced degrees.

¶ THE MEDICAL SCHOOL, in Chicago, is one of the best equipped in the United States and its reputation for efficiency is well-established. Numerous hospitals in close proximity are open to students. Clinical material is abundant.

¶ THE LAW SCHOOL, in Chicago, offers unexcelled library and research facilities. Its courses leading to degrees prepare for practice in any state.

¶ THE COLLEGE OF ENGINEERING, on the campus in Evanston, offers a five-year course of technical training in a University environment, leading to the degrees of Bachelor of Science and Civil Engineer or Electrical Engineer.

¶ THE DENTAL SCHOOL, in Chicago, is recognized as one of the leading schools for dental training and investigation. Its clinical facilities are unsurpassed.

¶ THE SCHOOL OF MUSIC in three well-equipped buildings offers exceptional advantages for the thorough study of music, professional or otherwise. It is located in Evanston.

¶ THE SCHOOL OF COMMERCE, in Chicago and Evanston, offers professional and scientific education for business with emphasis on the training of business executives. Day and evening work, laboratory courses, and business research.

¶ THE SCHOOL OF ORATORY, in Evanston, is unique in having university relations. It offers a well arranged course in interpretative literature, and a special course in Physical Education for teachers.

For information regarding any School of the University, address the President's Office, Northwestern University Building, Chicago, Illinois.

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COLLEGE *of* ENGINEERING ANNOUNCEMENTS
1921-1922

Published Weekly by Northwestern University
Northwestern University Building
CHICAGO

Vol. XXI, No. 45 May 7, 1921

NORTHWESTERN UNIVERSITY

Special Advantages of the College of Engineering

A thorough professional course rather than a purely practical one, with five years of broad training.

Small classes in which each student receives an unusual amount of individual attention.

A splendid building designed for the purpose, and up-to-date apparatus carefully selected to promote effective teaching.

Accessibility to great engineering projects, with unsurpassed opportunities to meet engineers and keep in touch with engineering practice.

A young thriving college in an old university.

Northwestern University Bulletin

COLLEGE *of* ENGINEERING ANNOUNCEMENTS

1921-1922

Published by the University
May, 1921

SWIFT HALL OF ENGINEERING

Swift Hall of Engineering, the gift of Mrs. Gustavus F. Swift and her son, Edward F. Swift, was dedicated in 1909. The building measures fifty-eight by one hundred and twenty-six feet; the exterior is of Bedford limestone, and presents architectural lines that are of the best; the interior is a model of appropriate decoration, convenience, safety and strength; it has concrete floors and stairways throughout. It presents five working stories, all well lighted and of good height, and the large rooms at the ends of the building are free from columns. From the beginning, it was especially planned as the home of the College of Engineering. The building is in a delightful location overlooking Lake Michigan.

Faculty

WALTER DILL SCOTT, Ph.D.
President

JOHN FILLMORE HAYFORD, C.E., Sc.D.
Director

OLIN HANSON BASQUIN, Ph.D.
Professor of Applied Mechanics

WILLIAM CHARLES BAUER, B.S., Sc.D.
Professor of Electrical Engineering

HERBERT SHAW PHILBRICK, B.A., B.S.
Professor of Mechanical Engineering

WILLIAM HENRY BURGER, B.S.
Professor of Civil Engineering

WILLIAM GRISWOLD SMITH, M.E.
Associate Professor of Drawing

ROYAL GILBERT BIGELOW, B.S.
Assistant Professor of Shop Work

HENRY CREW, Ph.D.
Professor of Physics

ULYSSES SHERMAN GRANT, Ph.D.
Professor of Geology

HORACE SECRIST, Ph.D.
Professor of Economics

David Raymond Curtiss, Ph.D.
Professor of Mathematics

William Frank Bryan, Ph.D.
Associate Professor of English

Winford Lee Lewis, Ph.D.
Professor of Chemistry

Elton James Moulton, Ph.D.
Associate Professor of Mathematics

Frederick Laird Kerr, M.A.
Registrar

Vivien K. Rathbun
Assistant Registrar

Andrews Allen, C.E.
Lecturer on Contracts and Specifications

Elmer Martin Leesman, LL.B.
Lecturer on Contracts and Specifications

Marcus Lafayette West
Shop Assistant

Calendar

1921-1922

1921

Sept. 19	Mon.	Academic year 1921-1922 begins; examinations for admission; first day of registration
Sept. 22	Thu.	Class work begins
Nov. 24	Thu.	Thanksgiving Recess to Sunday, November 27, inclusive
Dec. 17	Sat.	Christmas Recess, to January 2, Monday, inclusive

1922

Jan. 3	Tue.	Class work resumed
Jan. 30	Mon.	Mid-year examinations begin
Feb. 9	Thu.	Second semester begins; class work resumed
Apr. 13	Thu.	Easter Recess, to April 18, Tuesday, inclusive
June 5	Mon.	Regular examinations begin
June 21	Wed.	SIXTY-FOURTH ANNUAL COMMENCEMENT
June 22	Thu.	Beginning of summer surveying
Aug. 2	Wed.	End of summer surveying

Historical Note

THE charter of Northwestern University was signed by the Governor of Illinois on January 28, 1851. The corporation consists of forty-two trustees. An amendment to the charter provides that no intoxicating liquors shall be sold within four miles of the University.

The trustees selected as the seat of the University a tract of land on the shore of Lake Michigan, twelve miles north from the heart of Chicago. Here in 1855 the first University building was erected and about its location has grown up the City of Evanston. Here are the College of Liberal Arts, the College of Engineering, the School of Music, and the School of Oratory. The schools of Medicine, Law, Dentistry and Commerce are located in the City of Chicago.

The College of Liberal Arts, the oldest department of the University, was opened to students in the fall of 1855. From its small beginning it has grown, not by rapid expansion or by large benefactions, but by steady gains along conservative lines—each of its sixty years adding some improvements to its physical and educational equipment. The work of the College of Liberal Arts is mainly directed toward furnishing opportunities for a liberal culture or general education. The regulations affecting the choice of studies are such that the student may elect a large part of his work along lines in which he is especially interested.

In recent years a demand for instruction in engineering gradually made itself felt. A gift for the erection of an engineering building at Evanston and for its endowment led the Trustees of the University to take action in June, 1907, resulting in the establishing of a College of Engineering. This gift came from Mrs. Gustavus F.

Swift and her son, Edward F. Swift. The building, known as the Swift Hall of Engineering, was dedicated in May, 1909. It is now occupied by the College of Engineering. The Department of Mathematics of the College of Liberal Arts also has offices and recitation rooms in the building.

In 1920-1921 the College of Engineering had a total registration of one hundred and fifty-five students.

STATEMENT OF PURPOSE

The purpose of the College of Engineering of Northwestern University is to furnish to each student a thorough training for the profession of engineering, combined with a general training of the man. The College aims to train engineers for the greatest average effectiveness in a lifetime rather than for the greatest effectiveness in the first year after graduation. It aims to develop a capacity for unlimited growth. Hence strong emphasis is laid on those studies which tend to develop the man as well as on those which furnish training in engineering.

In keeping with these ideals, the courses in engineering introduce an unusual number of those non-technical studies that serve to give a general education and to develop the thinking power of the students. Unusual stress is laid upon Mathematics, upon Physics and other sciences fundamental to engineering and upon the principles which are broadly applicable to all engineering. The courses are five years in length, because past experience among colleges of engineering shows that four years is too short a time for the thorough professional training contemplated. At the end of four years the student of engineering will have secured as thorough a general training as one who comes to Northwestern University for general training alone. In recognition of that fact, he will be given the degree of Bachelor of Science by the College of Liberal Arts. During the fifth year the general training of the student is continued and he completes his professional course in engineering.

The motto of the College is "Culture for Usefulness." This motto calls for an effort to obtain for the student the broadest

culture attainable in five years in order to equip him, as a man and as an engineer, for the greatest possible usefulness in the world in the united struggle of man for progress.

Requirements for Admission

Candidates for admission without entrance conditions must qualify by examination or by certificate on fifteen units of High School work. The unit is a course of study requiring a daily recitation on a prepared topic for a full school year, and covering in the various subjects the work defined in the University Catalog.

English, three units; Algebra, one and a half units; and Plane Geometry, one unit, are required of all candidates. A choice is allowed in the selection of other subjects, but the choice must include either four units of foreign language or two units of foreign language plus two units chosen from the following group: College Algebra one-half unit, Plane Trigonometry one-half unit, Solid Geometry one-half unit, Physics one unit, Chemistry one unit, Manual Training one or two units, and Mechanical Drawing one or two units. The choice of foreign language is limited to Latin, Greek, French, German and Spanish and a certain maximum number of units in each as indicated in the table which follows. A single unit of any language will be accepted to meet the specific foreign language requirement only when accompanied by at least three units of some other language or two units each of two others. The remaining five and one-half units required to make an aggregate of fifteen units may include any subjects commonly appearing as a part of a high school course, provided that no subject is presented for less than a half unit of credit. Vocal and instrumental music and physical training are not recognized for credit.

The following table indicates the subjects commonly presented for admission credit:

Latin	2, 3 or 4	units
Greek	2 or 3	units
German	2 or 3	units
French	2 or 3	units
Spanish	2	units
College Algebra	½	unit
Plane Trigonometry	½	unit
Solid Geometry	½	unit
Physiography	1	unit
Physics	1	unit
Botany	1	unit
Zoology	1	unit
Chemistry	1	unit
Ancient History	1	unit
Mediæval and Modern History	1	unit
English History	1	unit
American History (or with Civil Government)	1	unit
Civil Government	½	unit
Political Economy	½	unit
Commercial Geography	½	unit
Commercial Law	½	unit
Physiology	½	unit
Mechanical Drawing	1 or 2	units
Manual Training	1 or 2	units

One unit of entrance credit in Mechanical Drawing may be given for twelve hours work per week for a full school year, or an equivalent amount of time, provided the work is of an acceptable character. A second unit of credit may be given in Mechanical Drawing only in case the course in drawing taken in school covers the full equivalent of the course Engineering A1 of the College of Engineering.

One unit of entrance credit in Manual Training may be given for twelve hours work per week for a full school year, or an equivalent amount of time, provided the work is of an acceptable character. A second unit of credit may be given in Manual Training only in case the course in Manual Training taken in school covers the full equivalent of the course Engineering A2 of the College of Engineering.

For a statement in detail of the definitions of other entrance units consult the Catalog of the University.

Each student in engineering who has not presented Solid Geometry for entrance will be required to take Solid Geometry, three hours for one semester, in the first year. As this will be an extra task,

making it difficult for the student to keep up with his class, each candidate is advised to present this subject for entrance if possible.

So, too, there are various other ways in which a student in meeting the entrance requirements may by his selection of the subjects presented either lighten his later college work, or may so handicap himself as to make it difficult to secure an engineering degree in five years. For a general suggestion on this point, consult page 14.

A candidate may be admitted to the College of Engineering as a regular student with not more than two units of condition, but entrance conditions, if any, must be made up during the first year of residence.

Admission to the College of Engineering may be by certificate or by examination. Candidates for admission must be at least sixteen years of age. Graduates of academies or high schools should obtain certificates of work done, showing the ground covered and the grade received in each study. These certificates should be sent to the Registrar, College of Engineering, at least one week before the opening of the fall semester. It is advisable to send them in much earlier. Certificate blanks may be had on request. Candidates who cannot present such certificates may be admitted on examination. Examinations for this purpose will be held September 19, 1921.

ADVANCED STANDING

Students from other colleges seeking admission to this college must present evidence of honorable dismissal from the institution last attended and must present certificates showing (1) a full record of the applicant's preparation for college, (2) his college record, subject by subject, with the grade obtained in each subject and the year of the course in which it was taken. He should submit a catalog of his college, bearing his name, and of the issue current at the time of his admission to that college. Students from other colleges must first meet the entrance requirements to this college, after which the amount of advanced credit to be obtained by certificate will be estimated by a committee of the Faculty, but not finally placed to

his credit until the student has been in residence in this college for one semester. Advanced credit without examination will be given only for work done in an approved college. Claims for advanced credit must be made during the first year of residence and not later than September of the collegiate year in which the candidate expects to graduate.

College credit for work done in a secondary school in excess of the requirements for admission can be given only on examination provided through the Registrar's office, and on the basis of five semester hours of credit for one unit of work. An exception to the examination rule is made in foreign language subjects continued in college during the first year, where the subsequent work is a sufficient test of the quality of the earlier work. Applications for such credit and for examination must be made to the Registrar during the first semester of residence and the examination must be taken at one of the regular dates set, viz.: the Wednesday of the opening week in September, or the Saturday following regular examinations in February. Advanced credit can be allowed only in Mathematics, foreign languages, or such other subjects taken in the last year of the secondary school course as may be approved by the Committee on Advanced Standing. No examination for advanced credit will be allowed after the first year of residence nor in subjects foreign to the college curriculum.

Courses of Study

The College of Engineering offers two courses of study, each five years in length, one in Mechanical and Electrical Engineering and the other in Civil Engineering. These courses are alike in character and the same in content to the end of the third year.

For the satisfactory completion of the first four years of either course, the degree, Bachelor of Science, will be given by the College of Liberal Arts.

The degree, Electrical Engineer, will be given by the College of Engineering at the end of the five-year course in Mechanical and Electrical Engineering, and the degree, Civil Engineer, at the end of the five-year course in Civil Engineering.

COURSE IN MECHANICAL AND ELECTRICAL ENGINEERING

	Semester Hours	
	First Semester	Second Semester
Freshman Year		
Mechanical Drawing, Engineering A1, or Shop Work, Engineering A2	2	..
Shop Work, Engineering A2, or Mechanical Drawing, Engineering A1	..	2
Mathematics, Trigonometry, College Algebra and Analytical Geometry	3 or 5	3 or 5
English A1	3	3
French A	3	3
Chemistry A	4	4
Summer Work	..	2
Sophomore Year		
Calculus, Mathematics B1	3	3
Physics A1	4	4
German A	3	3
Surveying, Engineering B2	3	3
Shop Work, Engineering B1	1	1
English B1	2	2
Summer Surveying, Engineering B3	..	6

	Semester Hours	
	First Semester	Second Semester
Junior Year		
Physics B1	3	3
Descriptive Geometry, Kinematics, and Graphical Statics, Engineering C1	3	3
Chemistry B1	5	..
Geology A1	5	..
*Chemistry B2	..	5
*Geology A3 or Geology B9	..	4
Economics A	..	5
Summer Work	..	2
Senior Year		
Physics C1	3	3
Electrical Engineering, Engineering D6	3	3
Structural Mechanics, Engineering D3	3	3
Mathematics C1	5	..
Elective	..	5
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Summer Work	..	2
Fifth Year		
Advanced Electrical Engineering, Engineering E5	3	..
Electric Power Plant Engineering, Engineering E6	..	3
Thermodynamics, Engineering E1	3	..
Engines, Engineering E3	3	3
Hydraulic Engineering, Engineering E4	3	3
The Public Relation of Engineers, Engineering E2	..	2
Elective	3	..
Advanced Mechanics, Engineering E11, or Elective	..	3
Thesis, Engineering E7	2	3

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*The student may omit either Chemistry B2 or the second semester of Geology.

COURSE IN CIVIL ENGINEERING

The first three years of this course are the same as those in the course in Mechanical and Electrical Engineering.

	Semester Hours	
	First Semester	Second Semester
Senior Year		
Physics C1	3	3
Structural Mechanics, Engineering D3	3	3
Mathematics C1	5	..
Elective	..	5
Electrical Machinery, Engineering D5	3	..
Heat Engines, Engineering D4	..	3
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Summer Work	..	2
Fifth Year		
Structures, Engineering E9	5	..
Bridges, Engineering E8	..	5
Hydraulic Engineering, Engineering E4	3	3
Railroad Engineering, Engineering E10	4	..
The Public Relations of Engineers, Engineering E2	..	2
Elective	3	3
Thesis, Engineering E7	2	4

Each course may be taken precisely as shown above by a student who enters the College with the standard preparation which includes English three units, Algebra one and one-half units, Plane Geometry one unit, Solid Geometry one-half unit, French two units, and German two units. If however the student enters College deficient in any of the subjects enumerated in the preceding sentence and the deficiency is not counterbalanced by excess elsewhere in his preparation of the character indicated later in this paragraph, it will

be impossible for him to complete either engineering course in five years without securing more than an average of seventeen semester hours of credit in each semester. Only an exceptionally strong student may expect to secure more than seventeen hours of credit per semester. Certain subjects when accepted for entrance credit constitute an excess in the sense that they relieve the student offering them of some college work which would otherwise be required of him in the engineering courses. These are College Algebra, Plane Trigonometry, Chemistry, a second unit of Mechanical Drawing, a second unit of Manual Training, and such preparation in foreign language as will leave the student less than twelve semester hours of foreign language to be taken in college in order to meet the requirements for the degree of Bachelor of Science which are shown in the Catalog of the University. As an example it may be stated that a student who presents three units of German or Latin, and two of French, is required to take in college French A only, six semester hours, instead of both French A and German A as listed above, twelve semester hours.

For recitations or lectures one semester hour of credit is given for one period, fifty minutes, each week, during one semester. For shop work, drafting or laboratory work, one semester hour of credit is given for one three-hour period each week during one semester.

REQUIRED SUMMER WORK

During each of the three summers following the first, third and fourth years the student is required to do practical work for at least six weeks, of such a character as to furnish experience of value to him as a prospective engineer. The credit assigned to six weeks of such approved work is two semester hours.

Under this requirement, students have acted as rodmen on city surveys, rodmen on the United States Lake Survey, workers in the tool room of a factory, helpers in the installation of heavy machinery in a new steam-electric power plant, foremen of gangs of laborers, helpers in the wiring of telephone switchboards, assistants in cement testing, computers for the Carnegie Institution, inspectors with a

company engaged in electric lighting and power distribution, and have worked on milling and machine work, figuring estimates, making tracings, and on land and topographical surveys.

During the summer following the second year the student is required to do field work in surveying for six weeks immediately following commencement, Engineering B3, credit six semester hours. This is a regular college course under the direction of college professors.

DESCRIPTION OF COURSES

The following paragraphs give more specific information in regard to the separate courses enumerated above as together constituting the courses in Mechanical and Electrical Engineering and in Civil Engineering.

English A1. Composition and Rhetoric; Brief Survey of English Literature—Required of all students in their first year. Three semester hours throughout the year.

English A2. Composition and Rhetoric—Required of students whose preparation is found to be insufficient for English A1. The work of the first semester is continued two hours a week in the second semester and attendance is required until the student's work is brought consistently up to a satisfactory standard.

French A1. Advanced French—Composition, conversation, and dictation. Three semester hours throughout the year. Open to students who present two units of French for entrance. If the student has presented no French for entrance he must take French AA, five semester hours throughout one year, in college before being admitted to French A, or if he has presented one unit of French for entrance, he must ordinarily take French AB, three semester hours throughout one year, in college before being admitted to French A.

German A. Intermediate German—Modern prose writers, classic drama and lyrics. Three semester hours throughout the year.

Open to students who present two units of German for entrance. If the student has presented no German for entrance he must take German AA, five semester hours throughout one year, in college before being admitted to German A.

The student is required to take in college such language courses as will satisfy the language requirements for the degree of Bachelor of Science of the College of Liberal Arts. What these courses are will depend upon what the student has offered for admission. The minimum of foreign language for a student who meets the entrance requirements fully is six semester hours.

Mathematics. Plane Trigonometry, College Algebra, and Analytical Geometry—These courses, which together constitute freshman mathematics, for Engineering students, are a total of 8 semester hours. Open to students who have presented one and a half units of Algebra for admission.

Mathematics B1. Differential and Integral Calculus—A first course in Calculus, including its simpler applications. Open to students who have completed Mathematics A3, or an equivalent. Three semester hours throughout the year.

Mathematics C1. Advanced Calculus—Infinite series; Taylor's theorem; partial differentiation; differential geometry; definite integrals over curves, surfaces and volumes; the Eulerian functions; differential equations. Open to students who have completed Mathematics B1. Five semester hours in the first semester.

Physics A1. General Physics—First semester—General properties of matter, wave-motion, sound, heat. Second semester—Electricity, magnetism, light. An introductory course requiring no mathematics beyond the requirements for entrance to college, intended to acquaint the student with the elementary facts, the method, and the general principles of physical science. Text-book: Crew's General Physics. Three lectures and one laboratory exercise each week. Open to all students. Four semester hours throughout the year.

Physics B1. Mechanics—A theoretical and experimental study of the fundamental principles of Mechanics; an introduction to advanced Physics and Engineering. This is a course in pure Dynamics, and serves as an introduction to Applied Mechanics. Laboratory work in dynamics of rigid bodies, friction, and elasticity. Two lectures and one laboratory exercise each week. Open to students who have completed Physics A1, or its equivalent, and who have completed or are taking Mathematics B1. Three semester hours throughout the year.

Physics C1. Electricity and Magnetism—The fundamental phenomena and laws of magnetism, electrostatics, steady currents, electrolysis, thermoelectricity, and electromagnetism. The laboratory work includes the measurement by one or more methods of current, resistance, electromotive force, temperature-coefficients, capacity; a study of the magnetic properties of iron and steel, thermoelectric effects, the use of the electrometer, the Carey Foster bridge, potentiometer, copper coulometer, etc. Open to students who have completed Mathematics B1 and who have completed or are taking Physics B1. Two lectures and one laboratory exercise each week. Three semester hours throughout the year.

Chemistry A1. General Chemistry—Text and laboratory work. Open to all students. Five semester hours throughout the year.

Chemistry A2. General Chemistry—Text and laboratory work. Open to students who present a year of high school chemistry for admission. Five semester hours throughout the year.

Chemistry B1. Qualitative Analysis—Analysis of simple mixtures accompanied by lectures and quizzes. Recitations and laboratory work. Open to students who have completed Chemistry A1 or A2. Five semester hours for one semester, to be taken in either semester. One semester hour is credited as an elective.

Chemistry B2. Organic Chemistry—Lectures and quizzes on the hydrocarbons and their derivatives. Laboratory preparation and study of typical organic compounds. Recitations and laboratory work. Open to students who have completed Chemistry B1 or an equivalent. Five semester hours for one semester, to be taken in either semester. One semester hour is credited as an elective.

Geology A1. General Geology—A general introduction to Geology. Lectures, recitations and laboratory work. Open to Sophomores, Juniors and Seniors. Five semester hours in the first semester only. One semester hour is credited as an elective.

Geology A3. Mineralogy—Crystallography, descriptive mineralogy, and determinative mineralogy of the common ores and rock forming minerals. Open to students who have completed in college or in high school a year course in Chemistry. Four semester hours in the second semester only.

Geology B5. Metallurgy—Fuels, refractory and cementing materials, metallurgy of iron and steel. Open to those students of Engineering who have completed Chemistry A. Two semester hours in the first semester only.

Geology B9. Historical Geology—A history of the earth, with special reference to the evolution of the North American Continent. Open to students who have completed Geology A1. Four semester hours in the second semester only.

Economics A. The Elements of Economics—An examination of the fundamental principles of economics, and the application of these principles to practical problems. Open to Sophomores, Juniors and Seniors. Five semester hours for one semester, to be taken in either semester.

English B1. Types of English Literature; Composition—Lectures, recitations, written reports and themes, and reading. Open to students who have completed the required English of the first year. Two semester hours throughout the year.

Electives—Five semester hours of electives are provided for in the senior year of both courses, and six in the fifth year. These electives are limited to courses given in the College of Liberal Arts, the choice to be approved by the Director, with the exception that Engineering E11 may be taken as an elective in the fifth year of the Mechanical and Electrical Engineering course.

Engineering A1. Mechanical Drawing—An elementary course in the technique of mechanical drawing, requiring no previous knowledge of drawing. Freehand lettering, exercise drawing, freehand sketching, shop drawing in pencil, tracing in ink on tracing cloth. Open to all students. Two drawing periods each week. Two semester hours for one semester, to be taken in either semester.

Engineering A2. Freshman Shop Work—A series of elementary practical exercises in the shop, upon a wide variety of subjects, the object being to bring out the principles involved, to acquaint the student with a considerable range of mechanical experience, and to cultivate habits both of logical thinking and of accurate work. The exercises involve some wood turning, filing, scraping, sawing, brazing, metal turning, shaping, planing, milling, grinding, etc. These exercises are guided by assigned readings, blue-printed instructions and by lectures on mechanical principles and processes, with occasional written work. Open to all students. Two shop periods each week. Two semester hours for one semester, to be taken in either semester.

Ordinarily it is expected that an engineering student will take Engineering A1 in one semester and Engineering A2 in the other semester of his freshman year.

Engineering B1. Sophomore Shop Work—This is a more intensive course than Engineering A2, limited mainly to pattern work, machine work, and tool making. The work is upon problems rather than exercises, and in them the student is given an opportunity to show his ingenuity and his grasp of the subject; while his work is directed in a general way, he is not given detailed instructions. The objects made are generally parts of some machine; this emphasizes the need for accuracy and gives a practical turn and interest to the subject. The work naturally introduces the student to a somewhat advanced knowledge of machines and processes. Open to students who have completed Engineering A2. One shop period each week. One semester hour throughout the year.

Engineering B2. Surveying—The use of chains, tapes, compass, level, transit, and plane table; methods of land, topographic and hydrographic surveying, stream measurement, mine surveying and city surveying. Open to students who have completed Engineering A1 and Trigonometry, College Algebra and Analytical Geometry. Two recitations and one field period each week. Three semester hours throughout the year.

Engineering B3. Summer Surveying—Applications under actual field conditions of the theory taught in Engineering B2. The outcome of the work will be a map of the region covered by the survey and much allied information. A new area will be covered each year, ordinarily adjacent to the area surveyed in the preceding year. Six weeks immediately following commencement. Open to students who have completed Engineering B2. Credit six semester hours.

Engineering C1. Descriptive Geometry, Kinematics, and Graphical Statics—The course is divided into three equal parts, dealing mainly with fundamental principles: (1) Descriptive Geometry; principles of orthographic projection; plane and curved surfaces, intersections and developments. (2) Kinematics; relative motions, transmission by link work, rolling and sliding contact, gear and cam design. (3) Graphic Statics; general principles, concurrent and non-concurrent forces, moments, roof trusses, reactions, stresses, wind load stresses, cantilever and unsymmetrical trusses. Open to students who have completed Engineering A1 and Trigonometry, College Algebra and Analytical Geometry. One recitation period and two drawing periods each week. Three semester hours throughout the year.

Engineering D1. Contracts and Specifications—The course deals with contracts and specifications as applied to engineering only. Recitations and lectures. Text-book: The Law of Contracts, by John C. Wait. Open to students who have sixty hours of credit. Two semester hours in the second semester only.

Engineering D2. Journal Meeting—The time is spent in reading and reviewing current engineering literature, the object being to acquaint the student with this fund of information, to show him the necessity of judicious selection from the great mass of such current literature, to indicate methods of selection, and to cultivate a habit of accurate reading. Open to students who have taken or who are taking Engineering D3, D4, D5, or D6. One laboratory period each week. One semester hour throughout the year.

Engineering D3. Structural Mechanics—The text-book work is upon the application of mechanics to the elementary parts of structures, taking up properties of materials, testing materials, elementary theory of elasticity, stresses and strains of beams, columns, shafts, tubes, curved bars, springs and bodies in rapid rotation; stability of piles and retaining walls; elementary theory of reinforced concrete. The laboratory work relates partly to standard methods of testing materials such as steel and cement, but it is largely involved in an effort to bring to the clear comprehension of the student the various relations deduced in the text-book work upon the subject. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering D4. Heat Engines—A course in prime movers and general power plant equipment. Elementary thermodynamics. Construction and operation of steam engines, turbines and gas engines. Engine testing. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours in the second semester only.

Engineering D5. Electrical Machinery—A course in Direct and Alternating Current Machines. Special emphasis is placed upon the study of the fundamental principles involved and upon the application of these principles in practise. Open to students who have completed Mathematics B1 and who are taking Physics C1. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering D6. Electrical Engineering—First semester—A general study of the fundamental principles of Electrical Engineering and their applications to direct current machinery. Problems are assigned to illustrate quantitatively the principles involved. Second semester—A general study of the fundamental principles of single and polyphase alternating currents, with special reference to analytic and graphic methods of treatment. Elementary analysis of alternating current machinery. Open to students who have completed Mathematics B1 and who are taking Physics C1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E1. Thermodynamics—The course consists of text-book work first upon the general theory of thermodynamics, and later upon its application to heat engines, taking up properties of gases, flow of gases, thermodynamics of air engines, internal combustion engines and air compressors, properties of steam and other vapors, thermodynamics of steam engines and steam turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Three semester hours in the first semester only.

Engineering E2. The Public Relations of Engineers—A course of lectures and reading dealing with the relations of a practising engineer to other men. It will deal in part with biographies of engineers, the history of engineering, the purpose of organization and the conservation of natural resources. Open to students who have taken or who are taking Engineering E1, E3, E4, E5, E6, E8 or E9. Two semester hours in the second semester only.

Engineering E3. Engines—A detailed study of the steam engine, steam turbine, boiler plant equipment, gas engines and producer gas plants. Open to students who have taken or who are taking Engineering E1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E4. Hydraulic Engineering—The theory and application of the principles of hydrostatics and hydrodynamics; measurements of flow by pressure gauges, meters, Pitot tubes and weirs; path, energy and impulse of jets; flow through orifices, tubes and pipes with loss of energy or head due to contractions, expansions and nozzles; derivation and application of formulæ for discharge, velocity and pressure; work derived from moving vanes as in water wheels and turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E5. Advanced Electrical Engineering—Advanced analysis by the analytic and graphic methods of treatment of continuous and alternating current machinery, of general alternating current and of transient phenomena. Lectures, assigned reading, recitations and laboratory work. Open to students who have completed Engineering D6. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering E6. Electric Power Plant Engineering—A study of the fundamental principles involved in the generation and transmission of electrical energy in large systems and in high potential systems. Emphasis is laid upon the proper relation of parts to form a complete plant. Lectures, assigned reading, recitations and laboratory work. Open to students who have completed Engineering E5. Two recitations and one laboratory period each week. Three semester hours in the second semester only.

Engineering E7. Thesis—Open to students in the last year in the Engineering course. Two semester hours in the first and four in the second semester in the Civil Engineering course and two in the first and three in the second in the Mechanical and Electrical Engineering course.

Engineering E8. Bridges—A general course on the theory and design of bridges, taking up stone arches, reinforced concrete arches, culverts and steel bridges of many types. Open to students who have completed Engineering D3. Three recitations and two drawing periods each week. Five semester hours in the second semester only.

Engineering E9. Structures—A general course on the theory and design of foundations, retaining walls, tall chimneys, masonry dams and building construction. Open to students who have completed Engineering D3. Three recitations and two drawing periods each week. Five semester hours in the first semester only.

Engineering E10. Railroad Engineering—The use of the transit, chain, level, etc., in laying out simple, compound and vertical curves; methods of reconnaissance, preliminary and location surveys; turnouts, switches and wye tracks; profile and cross section surveys, and computation of earthwork; haul and mass diagrams; maps and drawings; the use of topographic surveys in location; drainage, waterways and bridge staking. Economic theory of railway location, construction, extension and maintenance. Field work consists of laying out a short line and of the practical application of methods of staking, computation and mapping given above. Open to students who have completed Engineering B2 and Mathematics B1. Three recitations and one field period each week. Four semester hours in the first semester only.

Engineering E11. Advanced Mechanics—A study of the fundamental theory of structures and of certain structural members and machine elements common in mechanical and electrical engineering.

General Regulations

REGISTRATION

Every student is required to register in person at the office of the Registrar, College of Engineering, before entering upon college work, on the registration days specified in the calendar. Returning students who register after the close of this period are subject to a fee of two dollars.

On the registration days of the first semester the student must register for the work of the whole year. Changes may be made only with the consent of the Director. A course dropped without consent is regarded as a failure and is so recorded.

At the time of registration the student obtains from the Registrar his bill for tuition and fees for the semester. This should be paid at the Business Manager's Office within two weeks, otherwise a fee of $2.00 is added for late payments.

CLASSIFICATION

Students in the College of Engineering are grouped in five classes according to their credits in the office of the Registrar. The basis for their classification is as follows:

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first four years, and who have satisfied all entrance requirements, are classed as fifth year students.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first three years, and who have satisfied all entrance requirements, are classed as seniors.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first two years, and who have satisfied all entrance requirements, are classed as juniors.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first year, and

who have satisfied all entrance requirements, are classed as sophomores.

All other regular students are classed as freshmen, without regard to the date of admission.

GRADES OF SCHOLARSHIP, EXAMINATIONS, AND ATTENDANCE

In other matters of student regulation, such as examinations, grades of scholarship, class and chapel attendance, and physical training, the students of the College of Engineering are governed by the regulations stated in the Undergraduate's Manual.

FEES AND EXPENSES

Matriculation Fee, paid by each student when he first enters the University and before his first registration is complete	$ 5.00
Tuition and Incidentals, per year, except for Fifth Year students	200.00
Tuition and Incidentals, per year, for Fifth Year students	50.00

Tuition and Incidentals are payable one-half at the beginning of the first semester, one-half at the beginning of the second.

Laboratory Fees.

Engineering A1	$ 3.00 a semester
Engineering A2	8.00 a semester
Engineering B1	4.00 a semester
Engineering B2 or D3	5.00 a semester
Engineering C1, D4, D5, D6, E3, E4, E5, E6, E8, E9 or E10	3.00 a semester
Student Enterprise Fee	3.00 a semester
Fee for summer surveying course, Engineering B3	15.00
Diploma Fee	20.00

The average cost to a student of engineering for the first four years of all tuition and fees, as enumerated above, is about $222 per year.

The laboratory fees for engineering courses are intended to cover ordinary depreciation of apparatus and the use of materials. The student is held responsible for any damage due to his negligence.

Laboratory fees are not refunded if the student continues in a course as long as two weeks.

The tuition fees will not be refunded except in case of sickness. If a student withdraws before the middle of the semester, on account of serious illness, one-half of his tuition fee will be refunded on his obtaining from the Director a statement of honorable standing and from a physician a certificate that his health will not permit him to remain in attendance. Application for a refund must be made before the close of a semester in which the fee was paid.

Reduced rates of tuition are given to sons of ordained ministers in active service, or retired and not engaged in business ($60.00 per semester).

Holders of old-time perpetual or transferable scholarships are given free tuition.

A duplicate transcript of credit, when there has been no change in the amount of credit on record, will be issued only on payment of $1.00.

The University is not responsible for the loss of personal property belonging to students in any building owned by the University, whether by theft, fire or unknown cause.

DORMITORIES

A new system of thirteen dormitories for men students is now in use. Nine of these buildings are designed for fraternities, whose alumni have contributed toward their cost, and the remaining four are open for rental by any of the men students of the University.

The buildings are architecturally beautiful and are meant to be models in comfort and sanitation. They are fireproof, lighted by electricity, and heated by steam. On the first floor of each building is a large enclosed porch, and a well equipped club room with an open fire-place, rugs, tables, and lounging chairs. There are also a few rooms for individual students on this floor. The second and third floors are made up entirely of single rooms.

Each student's private room is furnished with a single bed, mattress and pillow, a chiffonier, a combined study table and bookcase, two chairs, a rug, and window shades. The student furnishes his own bedding and towels, but the University takes charge of the laundering of these. In the interest of economy, electric lighting is not included in the general charge, but is apportioned pro rata monthly to the occupants of the building.

In the men's dormitories room rent is payable at the beginning of each semester and the charge to each student for the use of a furnished single room, including care, heat and water, varies from one hundred and fifteen to two hundred dollars a year. The rental for private rooms on the first floor is somewhat higher.

The Registrar of the College of Liberal Arts is the renting officer of the dormitories; and men of the College of Engineering not living at their homes or in fraternity houses are required to live in the dormitories unless no rooms are available, or they obtain through the Registrar written permission to room elsewhere. Blank application forms for such permission will be furnished on request.

A chart showing the location and rental prices of rooms may be had from the Registrar upon application.

SCHOLARSHIPS

A few scholarships, worth $120 each, are awarded annually (five in 1920-1921) to select members of the incoming class, upon applications endorsed by the principal and faculty of the secondary school from which the applicant graduates. The applicant must meet the full entrance requirements and must present certificates from the teachers in his secondary school for excellence of character and scholarship, for physical vigor, manliness and promise of usefulness as a citizen. The award is made at the University by a committee of the College faculty.

A few scholarships, worth $120 each, are awarded annually (four in 1919-1920) to select members of the upper classes.

The upper class scholarship, worth $150, and known as the *Swift Scholarship*, has been given by Mrs. Gustavus F. Swift to members of the upper classes.

OPPORTUNITIES FOR SELF-HELP

Some students in Evanston have been able, while in college, to earn the cost of their living in full, and every year a large percentage earn a considerable portion of their expenses, and at the same time maintain a high standing in their studies. It is never advisable, however, for a student to undertake more work of this kind than is necessary for his personal support, and if the amount is excessive he should plan to give more than the normal five years to his college course.

The General Secretary of the Young Men's Christian Association maintains a bureau to assist students in finding employment. The positions most frequently open to young men are those as waiters at boarding places or as attendants in private houses in the care of gardens or furnaces. While the aggregate of the annual earnings of students is a large sum, the number of positions open is limited and no assurances can be given that employment will be found. Only the most faithful and self-reliant students should undertake self-support, and in no case should a student come to Evanston without sufficient means to meet expenses for at least a half-year.

RELIGIOUS AND SOCIAL LIFE OF STUDENTS

The charter of the University provides that "no particular religious faith shall be required of those who become students of this institution." Students are expected to attend public worship on Sunday in the church of their choice. Chapel service is held at ten o'clock three times each week throughout the college year. Under the direction of the Young Men's Christian Association religious meetings are held each week.

In athletics, in social life and in the use of the buildings, there is no separation of the students of Engineering from the students of

Liberal Arts. Engineering students go to the various buildings of the College of Liberal Arts for recitations in other than strictly engineering subjects. They share in the use of the University Library. They have free access to the new gymnasium, the largest in the United States. Their social life is mingled with that of the Liberal Arts students in one university group.

The Engineering Society, composed of students of engineering and members of the engineering faculty, provides numerous addresses by prominent engineers and organizes inspection trips to points of engineering interest. The members also furnish many additional programs so that the society holds a meeting nearly every week.

An Engineering Assembly, attended by all students of engineering and by the engineering faculty, occurs eight times during each year. The general purpose of these assemblies is to develop a group consciousness in the students of engineering and to bring forward matters of especial interest to the group.

Some Advantages of the College of Engineering at Northwestern University

It offers a thorough professional course rather than a purely practical course. It places the emphasis on the fundamentals which are common to all branches of engineering. It trains its graduates for unlimited growth as engineers and for possible leadership.

The engineering courses, five years in length, are so arranged as to give each man his general broad training at the same time that he pursues his engineering studies. The engineering students are closely associated with the larger group of Liberal Arts students, of which they, in fact, form a part.

In the purely engineering part of the course, the proportion of professors to students is much larger than is customary and each student, therefore, receives an unusual amount of attention.

There is more engineering in progress within fifty miles of the loop district of Chicago than in any area of the same size anywhere in the United States with the possible exception of New York City. The students of this College thus have an unsurpassed opportunity to keep in touch with engineering practise and to meet engineers.

The College of Engineering is a young organization in excellent condition to take advantage of the experience of other colleges in training engineers.

It is provided with ample shop and laboratory equipment, selected with unusual care and deliberation, purely for teaching purposes and housed in an excellent building.

Inquiries for further information, requests for the catalog of the University, for scholarship application blanks, and for blank forms of certificates from secondary schools may be addressed to John F. Hayford, Director, College of Engineering, Northwestern University, Evanston, Illinois.

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NORTHWESTERN UNIVERSITY

Special Advantages of the College of Engineering

A thorough professional course rather than a purely practical one, with five years of broad training.

Small classes in which each student receives an unusual amount of individual attention.

A splendid building designed for the purpose, and up-to-date apparatus carefully selected to promote effective teaching.

Accessibility to great engineering projects, with unsurpassed opportunities to meet engineers and keep in touch with engineering practice.

A young thriving college in an old university.

Northwestern University Bulletin

COLLEGE *of* ENGINEERING ANNOUNCEMENTS

1922-1923

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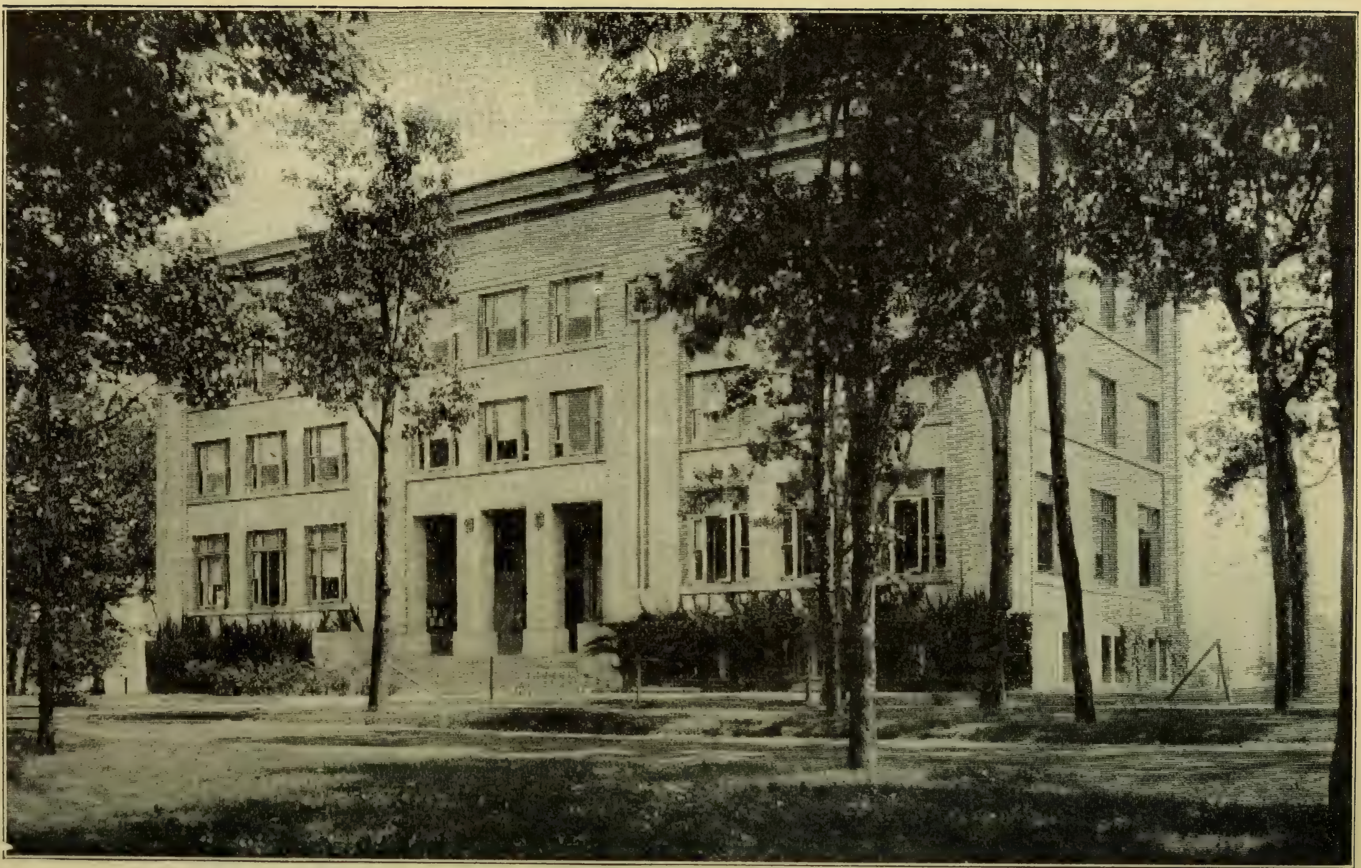
March, 1922



SWIFT HALL OF ENGINEERING

Swift Hall of Engineering, the gift of Mrs. Gustavus F. Swift and her son, Edward F. Swift, was dedicated in 1909. The building measures fifty-eight by one hundred and twenty-six feet; the exterior is of Bedford limestone, and presents architectural lines that are of the best; the interior is a model of appropriate decoration, convenience, safety and strength; it has concrete floors and stairways throughout. It presents five working stories, all well lighted and of good height, and the large rooms at the ends of the building are free from columns. From the beginning, it was especially planned as the home of the College of Engineering. The building is in a delightful location overlooking Lake Michigan.

Faculty

WALTER DILL SCOTT, Ph.D.
President

JOHN FILLMORE HAYFORD, C.E., Sc.D.
Director

OLIN HANSON BASQUIN, Ph.D.
Professor of Applied Mechanics

WILLIAM CHARLES BAUER, B.S., Sc.D.
Professor of Electrical Engineering

HERBERT SHAW PHILBRICK, B.A., B.S.
Professor of Mechanical Engineering

WILLIAM HENRY BURGER, B.S.
Professor of Civil Engineering

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Associate Professor of Drawing

ROYAL GILBERT BIGELOW, B.S.
Assistant Professor of Shop Work

HENRY CREW, Ph.D.
Professor of Physics

ULYSSES SHERMAN GRANT, Ph.D.
Professor of Geology

HORACE SECRIST, Ph.D.
Professor of Economics

David Raymond Curtiss, Ph.D.
Professor of Mathematics

William Frank Bryan, Ph.D.
Associate Professor of English

Winford Lee Lewis, Ph.D.
Professor of Chemistry

Elton James Moulton, Ph.D.
Associate Professor of Mathematics

Frederick Laird Kerr, M.A.
Registrar

Vivien K. Rathbun
Assistant Registrar

Andrews Allen, C.E.
Lecturer on Contracts and Specifications

Marcus Lafayette West
Shop Assistant

Calendar

1922-1923

1922

Sept. 18, Mon.	Academic year 1922-1923 begins; examinations for admission; first day of registration
Sept. 21 Thu.	Class work begins
Nov. 30 Thu.	Thanksgiving Recess to Sunday, December 3, inclusive
Dec. 21 Thu.	Christmas Recess, to January 2, inclusive.

1923

Jan. 3 Wed.	Class work resumed
Jan. 29 Mon.	Mid-year examinations begin
Feb. 8 Thu.	Second semester begins; class work resumed
Mar. 29 Thu.	Easter Recess, to April 3, Tuesday, inclusive
June 4 Mon.	Regular examinations begin
June 18 Mon.	SIXTY-FIFTH ANNUAL COMMENCEMENT
June 19 Tue.	Beginning of summer surveying
July 31 Mon.	End of summer surveying

Historical Note

THE charter of Northwestern University was signed by the Governor of Illinois on January 28, 1851. The corporation consists of forty-two trustees. An amendment to the charter provides that no intoxicating liquors shall be sold within four miles of the University.

The trustees selected as the seat of the University a tract of land on the shore of Lake Michigan, twelve miles north from the heart of Chicago. Here in 1855 the first University building was erected and about its location has grown up the City of Evanston. Here are the College of Liberal Arts, the College of Engineering, the School of Music, and the School of Oratory. The schools of Medicine, Law, Dentistry and Commerce are located in the City of Chicago.

The College of Liberal Arts, the oldest department of the University, was opened to students in the fall of 1855. From its small beginning it has grown, not by rapid expansion or by large benefactions, but by steady gains along conservative lines—each of its sixty years adding some improvements to its physical and educational equipment. The work of the College of Liberal Arts is mainly directed toward furnishing opportunities for a liberal culture or general education. The regulations affecting the choice of studies are such that the student may elect a large part of his work along lines in which he is especially interested.

In recent years a demand for instruction in engineering gradually made itself felt. A gift for the erection of an engineering building at Evanston and for its endowment led the Trustees of the University to take action in June, 1907, resulting in the establishing of a College of Engineering. This gift came from Mrs. Gustavus F.

Swift and her son, Edward F. Swift. The building, known as the Swift Hall of Engineering, was dedicated in May, 1909. It is now occupied by the College of Engineering. The Department of Mathematics of the College of Liberal Arts also has offices and recitation rooms in the building.

In 1921-1922 the College of Engineering had a total registration of one hundred and sixty-eight students.

STATEMENT OF PURPOSE

The purpose of the College of Engineering of Northwestern University is to furnish to each student a thorough training for the profession of engineering, combined with a general training of the man. The College aims to train engineers for the greatest average effectiveness in a lifetime rather than for the greatest effectiveness in the first year after graduation. It aims to develop a capacity for unlimited growth. Hence strong emphasis is laid on those studies which tend to develop the man as well as on those which furnish training in engineering.

In keeping with these ideals, the courses in engineering introduce an unusual number of those non-technical studies that serve to give a general education and to develop the thinking power of the students. Unusual stress is laid upon Mathematics, upon Physics and other sciences fundamental to engineering and upon the principles which are broadly applicable to all engineering. The courses are five years in length, because past experience among colleges of engineering shows that four years is too short a time for the thorough professional training contemplated. At the end of four years the student of engineering will have secured as thorough a general training as one who comes to Northwestern University for general training alone. In recognition of that fact, he will be given the degree of Bachelor of Science by the College of Liberal Arts. During the fifth year the general training of the student is continued and he completes his professional course in engineering.

The motto of the College is "Culture for Usefulness." This motto calls for an effort to obtain for the student the broadest

culture attainable in five years in order to equip him, as a man and as an engineer, for the greatest possible usefulness in the world in the united struggle of man for progress.

Requirements for Admission

Candidates for admission without entrance conditions must qualify by examination or by certificate on fifteen units of High School work. The unit is a course of study requiring a daily recitation on a prepared topic for a full school year, and covering in the various subjects the work defined in the University Catalog.

English, three units; Algebra, one and a half units; and Plane Geometry, one unit, are required of all candidates. A choice is allowed in the selection of other subjects, but the choice must include either four units of foreign language or two units of foreign language plus two units chosen from the following group: College Algebra one-half unit, Plane Trigonometry one-half unit, Solid Geometry one-half unit, Physics one unit, Chemistry one unit, Manual Training one or two units, and Mechanical Drawing one or two units. The choice of foreign language is limited to Latin, Greek, French, German and Spanish and a certain maximum number of units in each as indicated in the table which follows. A single unit of any language will be accepted to meet the specific foreign language requirement only when accompanied by at least three units of some other language or two units each of two others. The remaining five and one-half units required to make an aggregate of fifteen units may include any subjects commonly appearing as a part of a high school course, provided that no subject is presented for less than a half unit of credit. Vocal and instrumental music and physical training are not recognized for credit.

The following table indicates the subjects commonly presented for admission credit:

Latin	2, 3 or 4	units
Greek	2 or 3	units
German	2 or 3	units
French	2 or 3	units
Spanish	2	units
College Algebra	½	unit
Plane Trigonometry	½	unit
Solid Geometry	½	unit
Physiography	1	unit
Physics	1	unit
Botany	1	unit
Zoology	1	unit
Chemistry	1	unit
Ancient History	1	unit
Mediæval and Modern History	1	unit
English History	1	unit
American History (or with Civil Government)	1	unit
Civil Government	½	unit
Political Economy	½	unit
Commercial Geography	½	unit
Commercial Law	½	unit
Physiology	½	unit
Mechanical Drawing	1 or 2	units
Manual Training	1 or 2	units

One unit of entrance credit in Mechanical Drawing may be given for twelve hours work per week for a full school year, or an equivalent amount of time, provided the work is of an acceptable character. A second unit of credit may be given in Mechanical Drawing only in case the course in drawing taken in school covers the full equivalent of the course Engineering A1 of the College of Engineering.

One unit of entrance credit in Manual Training may be given for twelve hours work per week for a full school year, or an equivalent amount of time, provided the work is of an acceptable character. A second unit of credit may be given in Manual Training only in case the course in Manual Training taken in school covers the full equivalent of the course Engineering A2 of the College of Engineering.

For a statement in detail of the definitions of other entrance units consult the Catalog of the University.

Each student in engineering who has not presented Solid Geometry for entrance will be required to take Solid Geometry, three hours for one semester, in the first year. As this will be an extra task,

making it difficult for the student to keep up with his class, each candidate is advised to present this subject for entrance if possible.

So, too, there are various other ways in which a student in meeting the entrance requirements may by his selection of the subjects presented either lighten his later college work, or may so handicap himself as to make it difficult to secure an engineering degree in five years. For a general suggestion on this point, consult page 14.

A candidate may be admitted to the College of Engineering as a regular student with not more than two units of condition, but entrance conditions, if any, must be made up during the first year of residence.

Admission to the College of Engineering may be by certificate or by examination. Candidates for admission must be at least sixteen years of age. Graduates of academies or high schools should obtain certificates of work done, showing the ground covered and the grade received in each study. These certificates should be sent to the Registrar, College of Engineering, at least one week before the opening of the fall semester. It is advisable to send them in much earlier. Certificate blanks may be had on request. Candidates who cannot present such certificates may be admitted on examination. Examinations for this purpose will be held September 18, 1922.

ADVANCED STANDING

Students from other colleges seeking admission to this college must present evidence of honorable dismissal from the institution last attended and must present certificates showing (1) a full record of the applicant's preparation for college, (2) his college record, subject by subject, with the grade obtained in each subject and the year of the course in which it was taken. He should submit a catalog of his college, bearing his name, and of the issue current at the time of his admission to that college. Students from other colleges must first meet the entrance requirements to this college, after which the amount of advanced credit to be obtained by certificate will be estimated by a committee of the Faculty, but not finally placed to

his credit until the student has been in residence in this college for one semester. Advanced credit without examination will be given only for work done in an approved college. Claims for advanced credit must be made during the first year of residence and not later than September of the collegiate year in which the candidate expects to graduate.

College credit for work done in a secondary school in excess of the requirements for admission can be given only on examination provided through the Registrar's office, and on the basis of five semester hours of credit for one unit of work. An exception to the examination rule is made in foreign language subjects continued in college during the first year, where the subsequent work is a sufficient test of the quality of the earlier work, and in Plane Trigonometry, College Algebra, and Analytical Geometry after the successful completion of a more advanced course in College. Applications for such credit and for examination must be made to the Registrar during the first semester of residence and the examination must be taken at one of the regular dates set, viz.: the Wednesday of the opening week in September, or the second Saturday in January. Advanced credit can be allowed only in Mathematics, foreign languages, or such other subjects taken in the last year of the secondary school course as may be approved by the Committee on Advanced Standing. No examination for advanced credit will be allowed after the first year of residence nor in subjects foreign to the college curriculum.

Courses of Study

The College of Engineering offers two courses of study, each five years in length, one in Mechanical and Electrical Engineering and the other in Civil Engineering. These courses are alike in character and the same in content to the end of the third year.

For the satisfactory completion of the first four years of either course, the degree, Bachelor of Science, will be given by the College of Liberal Arts.

The degree, Electrical Engineer, will be given by the College of Engineering at the end of the five-year course in Mechanical and Electrical Engineering, and the degree, Civil Engineer, at the end of the five-year course in Civil Engineering.

COURSE IN MECHANICAL AND ELECTRICAL ENGINEERING

	Semester Hours	
	First Semester	Second Semester
Freshman Year		
Mechanical Drawing, Engineering A1, or Shop Work, Engineering A2	2	..
Shop Work, Engineering A2, or Mechanical Drawing, Engineering A1	..	2
Mathematics, Trigonometry, College Algebra and Analytical Geometry	3 or 5	3 or 5
English A1	3	3
French A	3	3
Chemistry A	4	4
Summer Work	..	2
Sophomore Year		
Calculus, Mathematics B1	3	3
Physics A1	4	4
German A	3	3
Surveying, Engineering B2	3	3
Shop Work, Engineering B1	1	1
English B1	2	2
Summer Surveying, Engineering B3	..	6

	Semester Hours First Semester	Semester Hours Second Semester
Junior Year		
Physics B1	3	3
Descriptive Geometry, Kinematics, and Graphical Statics, Engineering C1	3	3
Chemistry B1	5	..
Geology A1	5	..
*Chemistry B2	..	5
*Geology A3 or Geology B9	..	4
Economics A	..	5
Summer Work	..	2
Senior Year		
Physics C1	3	3
Electrical Engineering, Engineering D6	3	3
Structural Mechanics, Engineering D3	3	3
Mathematics C1	3	..
Elective	2	5
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Summer Work	..	2
Fifth Year		
Advanced Electrical Engineering, Engineering E5	3	..
Electric Power Plant Engineering, Engineering E6	..	3
Thermodynamics, Engineering E1	4	..
Engines, Engineering E3	3	3
Hydraulic Engineering, Engineering E4	3	3
The Public Relation of Engineers, Engineering E2	..	2
Elective	2	2
Thesis, Engineering E7	2	4

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*The student may omit either Chemistry B2 or the second semester of Geology.

COURSE IN CIVIL ENGINEERING

The first three years of this course are the same as those in the course in Mechanical and Electrical Engineering.

	Semester Hours First Semester	 Second Semester
Senior Year		
Physics C1	3	3
Structural Mechanics, Engineering D3	3	3
Mathematics C1	3	..
Elective	2	5
Electrical Machinery, Engineering D5	3	..
Heat Engines, Engineering D4	..	3
Geology B5	2	..
Contracts and Specifications, Engineering D1	..	2
Journals, Engineering D2	1	1
Summer Work	..	2
Fifth Year		
Structures, Engineering E9	5	..
Bridges, Engineering E8	..	5
Hydraulic Engineering, Engineering E4	3	3
Railroad Engineering, Engineering E10	4	..
The Public Relations of Engineers, Engineering E2	..	2
Elective	3	3
Thesis, Engineering E7	2	4

Each course may be taken precisely as shown above by a student who enters the College with the standard preparation which includes English three units, Algebra one and one-half units, Plane Geometry one unit, Solid Geometry one-half unit, French two units, and German two units. If however the student enters College deficient in any of the subjects enumerated in the preceding sentence and the deficiency is not counterbalanced by excess elsewhere in his preparation of the character indicated later in this paragraph, it will

be impossible for him to complete either engineering course in five years without securing more than an average of seventeen semester hours of credit in each semester. Only an exceptionally strong student may expect to secure more than seventeen hours of credit per semester. Certain subjects when accepted for entrance credit constitute an excess in the sense that they relieve the student offering them of some college work which would otherwise be required of him in the engineering courses. These are College Algebra, Plane Trigonometry, Chemistry, a second unit of Mechanical Drawing, a second unit of Manual Training, and such preparation in foreign language as will leave the student less than twelve semester hours of foreign language to be taken in college in order to meet the requirements for the degree of Bachelor of Science which are shown in the Catalog of the University. As an example it may be stated that a student who presents three units of German or Latin, and two of French, is required to take in college French A only, six semester hours, instead of both French A and German A as listed above, twelve semester hours.

For recitations or lectures one semester hour of credit is given for one period, fifty minutes, each week, during one semester. For shop work, drafting or laboratory work, one semester hour of credit is given for one three-hour period each week during one semester.

REQUIRED SUMMER WORK

During each of the three summers following the first, third and fourth years the student is required to do practical work for at least six weeks, of such a character as to furnish experience of value to him as a prospective engineer. The credit assigned to six weeks of such approved work is two semester hours.

Under this requirement, students have acted as rodmen on city surveys, rodmen on the United States Lake Survey, workers in the tool room of a factory, helpers in the installation of heavy machinery in a new steam-electric power plant, foremen of gangs of laborers, helpers in the wiring of telephone switchboards, assistants in cement testing, computers for the Carnegie Institution, inspectors with a

company engaged in electric lighting and power distribution, and have worked on milling and machine work, figuring estimates, making tracings, and on land and topographical surveys.

During the summer following the second year the student is required to do field work in surveying for six weeks immediately following commencement, Engineering B3, credit six semester hours. This is a regular college course under the direction of college professors.

DESCRIPTION OF COURSES

The following paragraphs give more specific information in regard to the separate courses enumerated above as together constituting the courses in Mechanical and Electrical Engineering and in Civil Engineering.

English A1. Composition and Rhetoric; Brief Survey of English Literature—Required of all students in their first year. Three semester hours throughout the year.

English A2. Composition and Rhetoric—Required of students whose preparation is found to be insufficient for English A1. The work of the first semester is continued two hours a week in the second semester and attendance is required until the student's work is brought consistently up to a satisfactory standard.

English B1. Types of English Literature; Composition—Lectures, recitations, written reports and themes, and reading. Open to students who have completed the required English of the first year. Two semester hours throughout the year.

French A1. Advanced French—Composition, conversation, and dictation. Three semester hours throughout the year. Open to students who present two units of French for entrance. If the student has presented no French for entrance he must take French AA, five semester hours throughout one year, in college before being admitted to French A, or if he has presented one unit of French for entrance, he must ordinarily take French AB, three semester hours throughout one year, in college before being admitted to French A.

German A. Intermediate German—Modern prose writers, classic drama and lyrics. Three semester hours throughout the year. Open to students who present two units of German for entrance. If the student has presented no German for entrance he must take German AA, five semester hours throughout one year, in college before being admitted to German A.

The student is required to take in college such language courses as will satisfy the language requirements for the degree of Bachelor of Science of the College of Liberal Arts. What these courses are will depend upon what the student has offered for admission. The minimum of foreign language for a student who meets the entrance requirements fully is six semester hours.

Mathematics. Plane Trigonometry, College Algebra, and Analytical Geometry—These courses, which together constitute freshman mathematics, for Engineering students, are a total of 8 semester hours. Open to students who have presented one and a half units of Algebra for admission.

Mathematics B1. Differential and Integral Calculus—A first course in Calculus, including its simpler applications. Open to students who have completed Mathematics A3, or an equivalent. Three semester hours throughout the year.

Mathematics C1. Advanced Calculus—Infinite series; Taylor's theorem; partial differentiation; differential geometry; definite integrals over curves, surfaces and volumes; the Eulerian functions; differential equations. Open to students who have completed Mathematics B1. Three semester hours in the first semester.

Physics A1. General Physics—First semester—General properties of matter, wave-motion, sound, heat. Second semester—Electricity, magnetism, light. An introductory course requiring no mathematics beyond the requirements for entrance to college, intended to acquaint the student with the elementary facts, the method, and the general principles of physical science. Text-book: Crew's General Physics. Three lectures and one laboratory exercise each week. Open to all students. Four semester hours throughout the year.

Physics B1. Mechanics—A theoretical and experimental study of the fundamental principles of Mechanics; an introduction to advanced Physics and Engineering. This is a course in pure Dynamics, and serves as an introduction to Applied Mechanics. Laboratory work in dynamics of rigid bodies, friction, and elasticity. Two lectures and one laboratory exercise each week. Open to students who have completed Physics A1, or its equivalent, and who have completed or are taking Mathematics B1. Three semester hours throughout the year.

Physics C1. Electricity and Magnetism—The fundamental phenomena and laws of magnetism, electrostatics, steady currents, electrolysis, thermoelectricity, and electromagnetism. The laboratory work includes the measurement by one or more methods of current, resistance, electromotive force, temperature-coefficients, capacity; a study of the magnetic properties of iron and steel, thermoelectric effects, the use of the electrometer, the Carey Foster bridge, potentiometer, copper coulometer, etc. Open to students who have completed Mathematics B1 and who have completed or are taking Physics B1. Two lectures and one laboratory exercise each week. Three semester hours throughout the year.

Chemistry A1. General Chemistry—Text and laboratory work. Open to all students. Five semester hours throughout the year.

Chemistry A2. General Chemistry—Text and laboratory work. Open to students who present a year of high school chemistry for admission. Five semester hours throughout the year.

Chemistry B1. Qualitative Analysis—Analysis of simple mixtures accompanied by lectures and quizzes. Recitations and laboratory work. Open to students who have completed Chemistry A1 or A2. Five semester hours for one semester, to be taken in either semester. One semester hour is credited as an elective.

Chemistry B2. Organic Chemistry—Lectures and quizzes on the hydrocarbons and their derivatives. Laboratory preparation and study of typical organic compounds. Recitations and laboratory work. Open to students who have completed Chemistry B1 or an equivalent. Five semester hours for one semester, to be taken in either semester. One semester hour is credited as an elective.

Geology A1. General Geology—A general introduction to Geology. Lectures, recitations and laboratory work. Open to Sophomores, Juniors and Seniors. Five semester hours in the first semester only. One semester hour is credited as an elective.

Geology A3. Mineralogy—Crystallography, descriptive mineralogy, and determinative mineralogy of the common ores and rock forming minerals. Open to students who have completed in college or in high school a year course in Chemistry. Four semester hours in the second semester only.

Geology B5. Metallurgy—Fuels, refractory and cementing materials, metallurgy of iron and steel. Open to those students of Engineering who have completed Chemistry A. Two semester hours in the first semester only.

Geology B9. Historical Geology—A history of the earth, with special reference to the evolution of the North American Continent. Open to students who have completed Geology A1. Four semester hours in the second semester only.

Economics A. The Elements of Economics—An examination of the fundamental principles of economics, and the application of these principles to practical problems. Open to Sophomores, Juniors and Seniors. Five semester hours for one semester, to be taken in either semester.

Electives—Seven semester hours of electives are provided for in the senior year of both courses. Six are provided in the fifth year of the Civil Engineering Course and four in the Electrical and Mechanical Course. These electives are limited to courses given in the College of Liberal Arts, the choice to be approved by the Director.

Engineering A1. Mechanical Drawing—An elementary course in the technique of mechanical drawing, requiring no previous knowledge of drawing. Freehand lettering, exercise drawing, freehand sketching, shop drawing in pencil, tracing in ink on tracing cloth. Open to all students. Two drawing periods each week. Two semester hours for one semester, to be taken in either semester.

Engineering A2. Freshman Shop Work—A series of elementary practical exercises in the shop, upon a wide variety of subjects, the object being to bring out the principles involved, to acquaint the student with a considerable range of mechanical experience, and to cultivate habits both of logical thinking and of accurate work. The exercises involve some wood turning, filing, scraping, sawing, brazing, metal turning, shaping, planing, milling, grinding, etc. These exercises are guided by assigned readings, blue-printed instructions and by lectures on mechanical principles and processes, with occasional written work. Open to all students. Two shop periods each week. Two semester hours for one semester, to be taken in either semester.

Ordinarily it is expected that an engineering student will take Engineering A1 in one semester and Engineering A2 in the other semester of his freshman year.

Engineering B1. Sophomore Shop Work—This is a more intensive course than Engineering A2, limited mainly to pattern work, machine work, and tool making. The work is upon problems rather than exercises, and in them the student is given an opportunity to show his ingenuity and his grasp of the subject; while his work is directed in a general way, he is not given detailed instructions. The objects made are generally parts of some machine; this emphasizes the need for accuracy and gives a practical turn and interest to the subject. The work naturally introduces the student to a somewhat advanced knowledge of machines and processes. Open to students who have completed Engineering A2. One shop period each week. One semester hour throughout the year.

Engineering B2. Surveying—The use of chains, tapes, compass, level, transit, and plane table; methods of land, topographic and hydrographic surveying, stream measurement, mine surveying and city surveying. Open to students who have completed Engineering A1 and Trigonometry, College Algebra and Analytical Geometry. Two recitations and one field period each week. Three semester hours throughout the year.

Engineering B3. Summer Surveying—Applications under actual field conditions of the theory taught in Engineering B2. The outcome of the work will be a map of the region covered by the survey and much allied information. A new area will be covered each year, ordinarily adjacent to the area surveyed in the preceding year. Six weeks immediately following commencement. Open to students who have completed Engineering B2. Credit six semester hours.

Engineering C1. Descriptive Geometry, Kinematics, and Graphical Statics—The course is divided into three equal parts, dealing mainly with fundamental principles: (1) Descriptive Geometry; principles of orthographic projection; plane and curved surfaces, intersections and developments. (2) Kinematics; relative motions, transmission by link work, rolling and sliding contact, gear and cam design. (3) Graphic Statics; general principles, concurrent and non-concurrent forces, moments, roof trusses, reactions, stresses, wind load stresses, cantilever and unsymmetrical trusses. Open to students who have completed Engineering A1 and Trigonometry, College Algebra and Analytical Geometry. One recitation period and two drawing periods each week. Three semester hours throughout the year.

Engineering D1. Contracts and Specifications—The course deals with contracts and specifications as applied to engineering only. Recitations and lectures. Open to students who have sixty hours of credit. Two semester hours in the second semester only. Not offered in 1922-23.

Engineering D2. Journal Meeting—The time is spent in reading and reviewing current engineering literature, the object being to acquaint the student with this fund of information, to show him the necessity of judicious selection from the great mass of such current literature, to indicate methods of selection, and to cultivate a habit of accurate reading. Open to students who have taken or who are taking Engineering D3, D4, D5, or D6. One laboratory period each week. One semester hour throughout the year.

Engineering D3. Structural Mechanics—The text-book work is upon the application of mechanics to the elementary parts of structures, taking up properties of materials, testing materials, elementary theory of elasticity, stresses and strains of beams, columns, shafts, tubes, curved bars, springs and bodies in rapid rotation; stability of piles and retaining walls; elementary theory of reinforced concrete. The laboratory work relates partly to standard methods of testing materials such as steel and cement, but it is largely involved in an effort to bring to the clear comprehension of the student the various relations deduced in the text-book work upon the subject. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering D4. Heat Engines—A course in prime movers and general power plant equipment. Elementary thermodynamics. Construction and operation of steam engines, turbines and gas engines. Engine testing. Open to students who have completed Physics B1 and Mathematics B1. Two recitations and one laboratory period each week. Three semester hours in the second semester only.

Engineering D5. Electrical Machinery—A course in Direct and Alternating Current Machines. Special emphasis is placed upon the study of the fundamental principles involved and upon the application of these principles in practise. Open to students who have completed Mathematics B1 and who are taking Physics C1. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering D6. Electrical Engineering—First semester—A general study of the fundamental principles of Electrical Engineering and their applications to direct current machinery. Problems are assigned to illustrate quantitatively the principles involved. Second semester—A general study of the fundamental principles of single and polyphase alternating currents, with special reference to analytic and graphic methods of treatment. Elementary analysis of alternating current machinery. Open to students who have completed Mathematics B1 and who are taking Physics C1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E1. Thermodynamics—The course consists of text-book work first upon the general theory of thermodynamics, and later upon its application to heat engines, taking up properties of gases, flow of gases, thermodynamics of air engines, internal combustion engines and air compressors, properties of steam and other vapors, thermodynamics of steam engines and steam turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Four semester hours in the first semester only.

Engineering E2. The Public Relations of Engineers—A course of lectures and reading dealing with the relations of a practising engineer to other men. It will deal in part with biographies of engineers, the history of engineering, the purpose of organization and the conservation of natural resources. Open to students who have taken or who are taking Engineering E1, E3, E4, E5, E6, E8 or E9. Two semester hours in the second semester only.

Engineering E3. Engines—A detailed study of the steam engine, steam turbine, boiler plant equipment, gas engines and producer gas plants. Open to students who have taken or who are taking Engineering E1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E4. Hydraulic Engineering—The theory and application of the principles of hydrostatics and hydrodynamics; measurements of flow by pressure gauges, meters, Pitot tubes and weirs; path, energy and impulse of jets; flow through orifices, tubes and pipes with loss of energy or head due to contractions, expansions and nozzles; derivation and application of formulæ for discharge, velocity and pressure; work derived from moving vanes as in water wheels and turbines. Open to students who have ninety semester hours of credit, including Mathematics B1 and Physics B1. Two recitations and one laboratory period each week. Three semester hours throughout the year.

Engineering E5. Advanced Electrical Engineering—Advanced analysis by the analytic and graphic methods of treatment of continuous and alternating current machinery, of general alternating current and of transient phenomena. Lectures, assigned reading, recitations and laboratory work. Open to students who have completed Engineering D6. Two recitations and one laboratory period each week. Three semester hours in the first semester only.

Engineering E6. Electric Power Plant Engineering—A study of the fundamental principles involved in the generation and transmission of electrical energy in large systems and in high potential systems. Emphasis is laid upon the proper relation of parts to form a complete plant. Lectures, assigned reading, recitations and laboratory work. Open to students who have completed Engineering E5. Two recitations and one laboratory period each week. Three semester hours in the second semester only.

Engineering E7. Thesis—Open to students in the last year in the Engineering course. Two semester hours in the first and four in the second semester.

Engineering E8. Bridges—A general course on the theory and design of bridges, taking up stone arches, reinforced concrete arches, culverts and steel bridges of many types. Open to students who have completed Engineering D3. Three recitations and two drawing periods each week. Five semester hours in the second semester only.

Engineering E9. Structures—A general course on the theory and design of foundations, retaining walls, tall chimneys, masonry dams and building construction. Open to students who have completed Engineering D3. Three recitations and two drawing periods each week. Five semester hours in the first semester only.

Engineering E10. Railroad Engineering—The use of the transit, chain, level, etc., in laying out simple, compound and vertical curves; methods of reconnaissance, preliminary and location surveys; turnouts, switches and wye tracks; profile and cross section surveys, and computation of earthwork; haul and mass diagrams; maps and drawings; the use of topographic surveys in location; drainage, waterways and bridge staking. Economic theory of railway location, construction, extension and maintenance. Field work consists of laying out a short line and of the practical application of methods of staking, computation and mapping given above. Open to students who have completed Engineering B2 and Mathematics B1. Three recitations and one field period each week. Four semester hours in the first semester only. Not offered in 1922-23.

General Regulations

REGISTRATION

Every student is required to register in person at the office of the Registrar, College of Engineering, before entering upon college work, on the registration days specified in the calendar. Returning students who register after the close of this period are subject to a fee of two dollars.

On the registration days of the first semester the student must register for the work of the whole year. Changes may be made only with the consent of the Director. A course dropped without consent is regarded as a failure and is so recorded.

At the time of registration the student obtains from the Registrar his bill for tuition and fees for the semester. This should be paid at the Business Manager's Office within ten days, otherwise a fee of $2.00 is added for late payments.

CLASSIFICATION

Students in the College of Engineering are grouped in five classes according to their credits in the office of the Registrar. The basis for their classification is as follows:

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first four years, and who have satisfied all entrance requirements, are classed as fifth year students.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first three years, and who have satisfied all entrance requirements, are classed as seniors.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first two years, and who have satisfied all entrance requirements, are classed as juniors.

Regular students who lack not more than fourteen semester hours of having completed all the courses prescribed for the first year, and

who have satisfied all entrance requirements, are classed as sophomores.

All other regular students are classed as freshmen, without regard to the date of admission.

GRADES OF SCHOLARSHIP, EXAMINATIONS, AND ATTENDANCE

In other matters of student regulation, such as examinations, grades of scholarship, class and chapel attendance, and physical training, the students of the College of Engineering are governed by the regulations stated in the Undergraduate's Manual.

FEES AND EXPENSES

Matriculation Fee, paid by each student when he first enters the University and before his first registration is complete	$ 5.00
Tuition and Incidentals, per year, except for Fifth Year students	200.00
Tuition and Incidentals, per year, for Fifth Year students	75.00
Fee for each hour of registration in excess of seventeen hours	7.00

Tuition and Incidentals are payable one-half at the beginning of the first semester, one-half at the beginning of the second.

Laboratory Fees.

Engineering A1	$ 3.00 a semester
Engineering A2	8.00 a semester
Engineering B1	4.00 a semester
Engineering B2 or D3	5.00 a semester
Engineering C1, D4, D5, D6, E3, E4, E5, E6, E8, E9 or E10	3.00 a semester
Student Enterprise Fee	3.00 a semester
Fee for summer surveying course, Engineering B3	15.00
Diploma Fee	20.00

The average cost to a student of engineering for the first four years of all tuition and fees, as enumerated above, is about $222 per year.

The laboratory fees for engineering courses are intended to cover ordinary depreciation of apparatus and the use of materials. The student is held responsible for any damage due to his negligence.

Laboratory fees are not refunded if the student continues in a course as long as two weeks.

The tuition fees will not be refunded except in case of sickness. If a student withdraws before the middle of the semester, on account of serious illness, one-half of his tuition fee will be refunded on his obtaining from the Director a statement of honorable standing and from a physician a certificate that his health will not permit him to remain in attendance. Application for a refund must be made before the close of a semester in which the fee was paid.

Reduced rates of tuition are given to sons of ordained ministers in active service, or retired and not engaged in business ($60.00 per semester).

A duplicate transcript of credit, when there has been no change in the amount of credit on record, will be issued only on payment of $1.00.

The University is not responsible for the loss of personal property belonging to students in any building owned by the University, whether by theft, fire or unknown cause.

DORMITORIES

A new system of thirteen dormitories for men students is now in use. Nine of these buildings are designed for fraternities, whose alumni have contributed toward their cost, and the remaining four are open for rental by any of the men students of the University.

The buildings are architecturally beautiful and are meant to be models in comfort and sanitation. They are fireproof, lighted by electricity, and heated by steam. On the first floor of each building is a large enclosed porch, and a well equipped club room with an open fire-place, rugs, tables, and lounging chairs. There are also a few rooms for individual students on this floor. The second and third floors are made up entirely of single rooms.

Each student's private room is furnished with a single bed, mattress and pillow, a chiffonier, a combined study table and bookcase, two chairs, a rug, and window shades. The student furnishes his own bedding and towels, but the University takes charge of the laundering of these. In the interest of economy, electric lighting is not included in the general charge, but is apportioned pro rata monthly to the occupants of the building.

In the men's dormitories room rent is payable at the beginning of each semester and the charge to each student for the use of a furnished single room, including care, heat and water, varies from one hundred and fifteen to two hundred dollars a year. The rental for private rooms on the first floor is somewhat higher.

The Registrar of the College of Liberal Arts is the renting officer of the dormitories; and men of the College of Engineering not living at their homes or in fraternity houses are required to live in the dormitories unless no rooms are available, or they obtain through the Registrar written permission to room elsewhere. Blank application forms for such permission will be furnished on request.

A chart showing the location and rental prices of rooms may be had from the Registrar upon application.

SCHOLARSHIPS

A few scholarships, worth $120 each, are awarded annually two in 1921-1922) to select members of the incoming class, upon applications endorsed by the principal and faculty of the secondary school from which the applicant graduates. The applicant must meet the full entrance requirements and must present certificates from the teachers in his secondary school for excellence of character and scholarship, for physical vigor, manliness and promise of usefulness as a citizen. The award is made at the University by a committee of the College faculty.

A few scholarships, worth $120 each, are awarded annually (four in 1921-1922) to select members of the upper classes.

The upper class scholarship, worth $150, and known as the *Swift Scholarship*, has been given by Mrs. Gustavus F. Swift to members of the upper classes.

OPPORTUNITIES FOR SELF-HELP

Some students in Evanston have been able, while in college, to earn the cost of their living in full, and every year a large percentage earn a considerable portion of their expenses, and at the same time maintain a high standing in their studies. It is never advisable, however, for a student to undertake more work of this kind than is necessary for his personal support, and if the amount is excessive he should plan to give more than the normal five years to his college course.

The General Secretary of the Young Men's Christian Association maintains a bureau to assist students in finding employment. The positions most frequently open to young men are those as waiters at boarding places or as attendants in private houses in the care of gardens or furnaces. While the aggregate of the annual earnings of students is a large sum, the number of positions open is limited and no assurances can be given that employment will be found. Only the most faithful and self-reliant students should undertake self-support, and in no case should a student come to Evanston without sufficient means to meet expenses for at least a half-year.

RELIGIOUS AND SOCIAL LIFE OF STUDENTS

The charter of the University provides that "no particular religious faith shall be required of those who become students of this institution." Students are expected to attend public worship on Sunday in the church of their choice. Chapel service is held at ten o'clock three times each week throughout the college year. Under the direction of the Young Men's Christian Association religious meetings are held each week.

In athletics, in social life and in the use of the buildings, there is no separation of the students of Engineering from the students of Liberal Arts. Engineering students go to the various buildings of the College of Liberal Arts for recitations in other than strictly engineering subjects. They share in the use of the University Library. They have free access to the new gymnasium, the largest in the United States. Their social life is mingled with that of the Liberal Arts students in one university group.

The Engineering Society, composed of students of engineering and members of the engineering faculty, provides numerous addresses by prominent engineers and organizes inspection trips to points of engineering interest. The members also furnish many additional programs so that the society holds a meeting nearly every week.

An Engineering Assembly, attended by all students of engineering and by the engineering faculty, occurs eight times during each year. The general purpose of these assemblies is to develop a group consciousness in the students of engineering and to bring forward matters of especial interest to the group.

Some Advantages of the College of Engineering at Northwestern University

It offers a thorough professional course rather than a purely practical course. It places the emphasis on the fundamentals which are common to all branches of engineering. It trains its graduates for unlimited growth as engineers and for possible leadership.

The engineering courses, five years in length, are so arranged as to give each man his general broad training at the same time that he pursues his engineering studies. The engineering students are closely associated with the larger group of Liberal Arts students, of which they, in fact, form a part.

In the purely engineering part of the course, the proportion of professors to students is much larger than is customary and each student, therefore, receives an unusual amount of attention.

There is more engineering in progress within fifty miles of the loop district of Chicago than in any area of the same size anywhere in the United States with the possible exception of New York City. The students of this College thus have an unsurpassed opportunity to keep in touch with engineering practise and to meet engineers.

The College of Engineering is a young organization in excellent condition to take advantage of the experience of other colleges in training engineers.

It is provided with ample shop and laboratory equipment, selected with unusual care and deliberation, purely for teaching purposes and housed in an excellent building.

Inquiries for further information, requests for the catalog of the University, for scholarship application blanks, and for blank forms of certificates from secondary schools may be addressed to John F. Hayford, Director, College of Engineering, Northwestern University, Evanston, Illinois.

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Northwestern University

Evanston — Chicago

¶ THE COLLEGE OF LIBERAL ARTS, ideally located in Evanston, offers well organized courses for general education, with special preparation for the professions and for other pursuits requiring broad training, and special courses in Religious Education and in Physical Education.

¶ THE GRADUATE SCHOOL, in Evanston, extends nonprofessional training and research beyond the College curriculum, with courses leading to advanced degrees.

¶ THE MEDICAL SCHOOL, in Chicago, is one of the best equipped in the United States and its reputation for efficiency is well-established. Numerous hospitals in close proximity are open to students. Clinical material is abundant.

¶ THE LAW SCHOOL, the oldest in Chicago, offers unexcelled library and research facilities. Its courses leading to degrees prepare for practice in any state.

¶ THE COLLEGE OF ENGINEERING, on the campus in Evanston, offers a five-year course of professional education in a University environment, leading to the degrees of Bachelor of Science and Civil Engineer or Electrical Engineer.

¶ THE DENTAL SCHOOL, in Chicago, is recognized as one of the leading schools for dental training and investigation. Its clinical facilities are unsurpassed.

¶ THE SCHOOL OF MUSIC in three well-equipped buildings offers exceptional advantages for the thorough study of music, professional or otherwise. It is located in Evanston.

¶ THE SCHOOL OF COMMERCE, in Chicago and Evanston, offers professional and scientific education for business with emphasis on the training of business executives. Day and evening work, laboratory courses, and business research.

¶ THE SCHOOL OF SPEECH, in Evanston, is a University Professional School. It offers courses in debate, public speaking and interpretation.

¶ THE SCHOOL OF EDUCATION, in Evanston, coordinates the pedagogical activities of the University and through the Department of Education in the College of Liberal Arts offers courses for every type of teaching. Awards University Certificate in Education.

¶ THE MEDILL SCHOOL OF JOURNALISM, in Chicago and Evanston, offers comprehensive courses in editing, news writing, reporting, newspaper administration.

For information regarding any School of the University, address the President's Office, Northwestern University Building, Chicago, Illinois.

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